PARK SCIENCE

A RESOURCE MANAGEMENT BULLETIN

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PARK SCIENCE

NATIONAL PARK SERVICE

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A report to park managers of recent and on-going research in parks with emphasis on its implications for planning and management

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Cover: *Bruce Connery from Wrangell-St. Elias NP accepts his diploma from NPS Director William Penn Mott, Jr. (Story on page 3).*

Editorial

Given the interconnectedness of every living thing that inhabits the envelope of this cell-like planet we call Earth, the *BioScience* article "Preparing for Climate Change" abstracted on page 12 of this issue could be describing one of the most serious challenges to park management that we have experienced or will experience in the foreseeable future.

As Stephen H. Schneider of the National Center for Atmospheric Research in Boulder, Colo., notes: "the phenomenon is one of the best-established theories in atmospheric science."

The particular problem that climate-change poses for parks is two-fold. First, there is the realization that in the real world of push-coming-to-shove, the fragile values are the first to crumple. And as we have found so often in the past, park values usually run a poor second to profits and jobs.

The second consideration is not-so-simply this: Given the first consideration, what can the National Park Service do to protect its resources? The answer is not something that can be neatly spelled out in an editorial or even in a tome. It must be carefully worked at, step by step, as the problems and the opportunities emerge. The recent conference has alerted resource managers to the "oneness" of what might otherwise be seen as a group of disconnected problems.

For instance, the overall warming of earth's atmosphere is fingered as a possibly major contributory factor in the death of coral reefs (see page 12 this issue). With the emerging recognition that climate change may be the trigger in a whole panoply of problem areas, the conferees began to look for ways to divide the issue into "chewable pieces, and start working on those pieces right now."

On Feb. 10, 1988, Interior Deputy Under Secretary Becky Norton Dunlap appointed a 12-person Departmental Working Group on Climate Change (DWGCC), chaired by Martin Smith, Deputy Assistant Secretary/Director, Office of Policy Analysis, to look into potential impacts of climate change on DI bureaus and to come up with short and long term options as possible responses and mitigation measures.

If the trend is found to be as swift and serious as some believe, then park resources such as certain animal and plant communities may be stressed beyond their abilities to survive – especially since most are now hemmed in by developments that prevent what would have been their former evolutionary escape routes. Whole ecosystems may even disappear – like the delicate, richly productive wetlands that could be drowned by a rise in ocean levels.

In the face of such possibilities, the NPS science program must ask itself if the inventory and monitoring guidelines now under consideration will give the baseline information needed against which to measure future climate-induced changes. In other words, are we ready to do our part in assessing the natural responses that seem to be taking place? And as we find the answers, can we set up in intra-System strategy for dealing with these changes?

It seems unlikely at this point that the greenhouse warming effect will turn out to be "an infrared herring" as Schneider put it. But as he concluded, we cannot wait too long to act: We "need to gaze into a very dirty crystal ball" and then decide "precisely how long to clean the glass before acting on what we think we see inside."

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Third Class of NRMS Trainees Complete 12 Month Program

By Richard L. Harris

The third class of Natural Resource Management Specialist trainees completed their 12 month program on Nov. 5, 1987, and were presented their certificates for completing the training by NPS Director Mott. The 20 participants began their training in November 1986 and participated in 22 weeks of intensive instruction at various National Parks and universities. The remaining time was spent at their respective parks or on additional training as part of their individual development.

Unlike the first two trainee classes, which were administered by the Office of the Associate Director for Natural Resources, this program was set up and run by the Division of Training in the Washington Office of Employee Development. For the 1986/87 trainee program, parks within the 10 NPS Regions identified the need for specialized resource management expertise. Training positions were then advertised and filled through vacancy announcements or training opportunities at the regional level. Although trainees for the second program were also selected on a regional basis, the candidates were selected through a single competitive personnel process with a list of qualified candidates prepared at the WASO level. Members of the first group of trainees were not selected through a competitive process, but were picked from parks that identified a need for additional resources management expertise and could allow a trainee time away from assigned duties to pursue formal coursework.

The third trainee program was conducted over a one year period instead of two as previous programs had been. However, approximately the same amount of time was devoted to academic coursework as during the second program. Academic coursework varied little from the second program, and exposed trainees to a broad range of resource problems and issues. For the majority of courses, trainees were required to pass an exam or complete and submit a post course paper.

Training completed during the program included: Computers and statistics and Natural Resource Policy and Law, held at Clemson University; NPS Administration, Budgeting, and Contracting, and NPS Planning and Cultural Resources Management at the NPS, Washington Office; Vegetation Management at UC Davis; Wildlife Management at Texas A&M; Air Quality, Integrated Pest Management, Geographic Information Systems, and Mining and Minerals at the Denver Service Center; Water Resources Management at Colorado State University; Fisheries and Aquatic Systems at Oregon State University; Fire Management at Boise Interagency Fire Center and Sequoia/Kings Canyon NP; Interpretation and Communications, and Situational Leadership at Harpers Ferry Training Center; and Conflict Resolution and Negotiation, and Coastal Process and Geomorphology, held at the NPS Washington Office.

In addition to structured courses, trainees participated in a two week resource management training practicum at Yellowstone NP. This was an optional training opportunity, which gave participants a chance to use some of the skills acquired during the program. Trainees spent time in the field working on projects dealing with fisheries management, bear management, and resource rehabilitation, to name a few. This constituted a break from the more academic coursework and allowed participants to experience resource issues facing the oldest National Park and the social impacts created during its peak visitation period.

Due to this program's one year duration, the in-park project required of the second trainee class was dropped. However, because all but one trainee remained at their respective parks at the end of the training, trainees were able to readily apply newly acquired skills and knowledge to ongoing projects and undertake others that could be carried through to completion after the program.

Because of the compressed time frame, travel and training made for a potentially stressful situation. Two trainees became fathers which made being away from home difficult at times. To help alleviate some of the pressures on the home front, spouses and families sometimes accompanied trainees at their own expense on trips during the summer months. This was encouraged by program coordinator, Dr. William Walker.

Although much was gained through the learning experiences provided, the resources of friends and other resource professionals will prove equally important throughout the trainees' careers. And the opportunity to experience first hand the resource issues facing parks throughout the system and to maintain

The graduates: *This year's graduating class of Natural Resource Management Specialist Trainees was recorded for posterity on the steps of the Interior Building in Washington, DC, by Rosa Wilson of the WASO office of public affairs. By name, Region, and duty station during training, they are: 1. Jeri Hall, NCR – GWMP; 2. Ruth Scott, PNR – OLYM; 3. Richard Bryant, SER – CANA; 4. Anne Marie LaRosa, WR – WRO; 5. Donna Shaver, SWR – PAIS; 6. Judy Hazen, NAR – ACAD; 7. Rick Harris, MWR – INDU; 8. Bruce Connery, AR – WRST; 9. Kate Kitchell, RMR – CANY; 10. Larry Katahira, WR – HAVO; 11. Rick Potts, MAR – SHEN; 12. Ken Stahlnecker, NCR – ANTI; 13. Ray Snow, RMR – THRO; 14. Carl Zimmerman, SER – GUIS; 15. Clive Pinnock, NAR – GATE; 16. Larry Norris, SWR – JELA; 17. John Apel, MAR – HOFU; 18. Dick Anderson, WR – SOAR; 19. Jim Hammett, PNR – NOCA; 20. Jack Delfke, MWR – WICR; and 21. Bill Walker, WASO, Coordinator of the trainee program.*

a dialogue with other trainees, proved beneficial for all.

Not unlike the members of the past two trainee programs, the third class was a diverse group consisting of 6 women and 14 men who ranged in age from 27 to 40 by the program's end. Nine have completed masters' degrees and 11 have completed bachelors', with one trainee now completing course work that will lead to a bachelor's in natural resource management. All had NPS field experience prior to entering the program.

During graduation exercises, Director Mott and Associate Director for Natural Resources, Eugene Hester, gave their support for the continuation of the program in 1988/89. A new program is scheduled to kick off at Clemson University the first week of April. The program will again be run under the direction of Reginald (Flip) Haygood in the WASO Office of Employee Development and coordinated by Dr. Walker.

***Director Mott** accepts the tee shirt that makes him one of the third NPS Natural Resource Specialist trainee graduating class.*

Partly based on input from this past group of trainees, the new program will run for a year and a half, allowing trainees to spend more time in their parks on current projects and to escape some of the pressures caused by continually being on the road. Filling trainee positions is being carried out in the same way as for the last program, and at present little change has been made in the academic structure. One difference is that the new group of trainees will have the option to develop and carry out a project if it fits in with the objectives of a park's overall resource management program.

In all, individuals who have been selected as trainees and parks that have benefited from them, have the highest regard for the program. The professional skills developed by trainees now makes them a valuable part of the cadre of natural resource professionals needed to effectively address resource issues that will continue to confront the NPS now and in the future.

The author is No. 7 in the class photo.

Improving the NPS Science Program: A Rejoinder

By R. Gerald Wright
CPSU University of Idaho Moscow, Idaho

***Editor's Note:** The editorial board of* Park Science *is grateful to Gerry Wright for sharing at this time the following information elicited by him from NPS scientists as part of his forthcoming book. The results of Wright's survey make interesting reading on the heels of the Jim Wood article that appeared on pages 22 and 23 of the Winter 1988 issue of* Park Science.

In June 1987 I sent out an informal questionnaire to all NPS scientists involved in fish and wildlife research to solicit their views on certain aspects of NPS research. I am currently writing a book dealing with the history of wildlife management and research in NPS, and the concluding chapter attempts to analyze the strengths and weaknesses of the NPS research program. I developed a questionnaire in order to gain input for this chapter. I recognize that the nature of the questionnaire required respondents to make generalizations on what are often subtle issues. Thus, even though there was considerable consensus on many issues, one needs to be cautious in interpreting these data.

Forty-four questionnaires were sent out; forty-one individuals returned them for a 93 percent response rate. All responses were anonymous. The responses to the first two questions are given below.

Question 1. How has the quality of the NPS natural science research program changed over the past 10-15 years?

	N	%
1) increased in quality	26	69
2) decreased in quality	1	2
3) remained about the same	11	29

Question 2. What importance do you place on publishing the results of research in recognized professional journals?

	N	%
1) very important	31	78
2) somewhat important	9	22
3) no opinion	0	0
4) minor importance	0	0
5) not important at all	0	0

The results indicate that NPS researchers place a great importance on publications. This was evident in the written comments attached to many questionnaires. Several individuals pointed to the need for an NPS technical report series as an outlet, particularly for management-oriented publications. The high interest in publications struck me as somewhat ironic because the reviews I have done of NPS scientific literature (for example Wright and Hayward 1985) have shown a low portion (‹ 20%) of NPS research winds up in professional journals.

The final question asked respondents to rank on a scale of one to five (from very important to not important), nine factors that were viewed as hindering research in National Parks. The replies (in percent) to this question, ranked in order of the number of responses in the first two categories, are shown in Table 1.

These responses seem to indicate that more than any other factor, the NPS natural science program could be greatly improved by better communication between scientists and managers. This is not a new problem. It was voiced time and again in interviews I have conducted with retired NPS biologists in the course of my research.

The feelings of scientists on the first three factors also match the perceptions independently derived by Jim Wood and discussed in the winter issue of *Park Science*. This publication, as well as the periodic science conferences, have attempted to bridge the communication gap and develop a dialog between managers and scientists. Clearly, additional efforts are needed if the problem is to be solved.

Citation:

Wright, R. G. and P. Hayward. 1985. National parks as research areas with a focus on Glacier N.P. Bull. Ecol. Soc. 66:354-357.

Table 1.

Factors that hinder research	most important ..... least important 1	2	3	4	5
Managers do not understand role that research should play in NPS mission	50	45	3	2	–
Lack of an agency research mandate	63	16	11	5	5
Managers distrust scientists	21	47	24	8	–
Supervision of scientists by non-scientists	27	40	15	10	8
Managers do not feel scientific research is important to park management	16	47	21	13	3
Scientists don't produce a timely or relevant product	13	41	47	–	–
Managers fear research findings will alter the management of their park	11	43	39	5	2
Researchers lack an understanding of management needs	10	34	39	15	2
Decentralized administrative structure of NPS science program	26	13	23	15	23

Asian School On Conservation Biology Affords NPS Teacher/Student Roles

Editor's Note: *Following is an excerpted account, by Cat Hawkins, Olympic NP Natural Resource Specialist, of her experience attending the First Asian School of Conservation Biology Dec. 14-31, 1987, in Bangalore, India. The entire text of her memorandum to the NPS Director will be carried in a future issue of the George Wright Society's FORUM.*

My initial impressions of India, and those that will endure longest, are of contrasts, vivid color, and raw, "unpolished" life. There is a vitality throughout India which stands in defiance to her areas of poverty. There is rich, *intense* color in garment, which, perhaps once an afterthought, is now purpose; it appropriately complements the rust and green landscape. And there is life unmatched by any save the ocean's – constant motion, and constant change.

It was into this world that I stepped as a representative from the National Park Service to the First Asian School on Conservation Biology. Organized by Prof. Madhav Gadgil, Dr. Raghavendra Gadagkar, and Dr. R. Sukumar, the course was held at the Indian Institute of Science in Bangalore. All of the approximately 60 participants, except Christine Schonewald-Cox and myself, were from Asian countries, including Afghanistan, Nepal, Indonesia, Sri Lanka, Malaysia, Japan, China, Pakistan, Bangladesh, and India.

The course began with a four day field trip to India's first biosphere reserve (established in 1986), in the Nilgiris, South India. The Bandipur Tiger Reserve, Nagarhole and Silent Valley National Parks, Mudumalai, Wynaad and Upper Nilgiris Wildlife Sanctuaries are included in the Reserve. Problems in managing these areas include fire, loss of habitat due to shifting cultivation and erosion, intensive livestock grazing, crop damage (from elephants), manslaughter by animals (tigers and elephants), and poaching. We traveled into the Reserve through teak, coffee, and tea plantations, past terraces growing cabbage, carrots, potatoes, and cauliflower, and finally to Avalanche, an area of evergreen montane forest (shola). In Bandipur and Mudumalai, we were fortunate to see wild elephants, sambar, spotted deer, gaur, bonnet macaque monkeys, flying squirrels, and boar, etc., as well as very different and very diverse bird life including the pariah kite, drongo, koel, and yellow wagtail.

The next 10 days featured instruction from Institute faculty and presentations by course participants. Core lectures addressed diversity from the genome level to that of species, population, and community. Immigration, emigration, extinction, inbreeding, and outbreeding, and their effects on population and community stability also were discussed.

Core lectures delivered by academicians aroused in some participants the apparently worldwide frustration of field managers over the perceived gap between theory and application. Later sessions helped to close this gap, with topics such as setting priorities for conservation, practical problems in conservation, and human cultures and conservation.

Schonewald-Cox gave well-received talks on landscape ecology and boundary theory as it applies to conservation in nature reserves. I spoke on the NPS policy regarding exotic species management with special reference to the mountain goat issue at Olympic NP.

Final sessions involved open discussion on future directions for conservation of biological diversity on the Asian continent. A likely outcome of the meeting will be a textbook on conservation biology using Asian examples and publication of a special issue of the journal *Conservation Biology,* with profiles of Asian country cases.

All meals *were served on the rooftop of the Center for Environmental Studies at the Indian Institute of Science in Bangalore. Here, Christine Schonewald-Cox (center) and Cat Hawkins (right) admire the special Christmas fruit cake and tree provided on Dec. 25, 1987, for the eight Christians in the class. At left is Geetha Gadagkar, in charge of catering.*

Some of my thinking about biosphere reserves, as a result of this conference, has been "fine tuned." I see the BRs as embodying simultaneously one of the greatest potentials and one of the greatest challenges to the conservation community. In core and multiple use zones of many BRs, inventories are incomplete. Managers are working to complete these inventories and generally have clear objectives and set operating procedures. Management of these areas follows a plan – a working "road map" exists to direct operations *within* these areas.

The challenge yet to be addressed in many reserves (from my perspective) is to prepare a similar road map for cooperative management within the reserve as a whole. Included areas may be of varied purposes, including traditional use, rehabilitation, experimental research, and/or multiple use zones. Some core area reserve managers are working actively with adjacent reserve area managers to develop mutual management objectives specifically to meet goals of the BR program, but many are not yet to this point. Of those who are (e.g. Glacier and Great Smoky Mountain NP BRs), most are operating upon personal initiative, without any instituted methodology to direct them. The Service could contribute to world conservation efforts by developing plans of mutual management objectives *specific* to the biosphere reserve concept.

Awareness within the NPS of the need for ethnographic resource conservation programs is increasing. A contribution to world conservation could be made by NPS areas in which preservation of contemporary traditional "lifeways" (see Douglas Scovill's article, *Trends,* Vol. 24, No. 4, 1987) is a concern. Ethnographic resource conservation programs for these areas (whether of BR status or not), developed to be consistent with natural resource preservation policies, would provide useful models for similar efforts worldwide.

Thus, by fashioning cooperative management programs *specific* to BR objectives, and by developing ethnographic resource conservation programs, I feel the NPS has additional contributions for worldwide conservation. Also, I feel we have much to learn from third world countries that regard us as "one or two hundred years ahead." In uses of technology, the U.S. may be ahead of developing Asian countries, but in many respects the problems now faced in these "third world" countries bear lessons for conservationists in the United States.

In both of these widely disparate situations, education of people to the need for conservation is a critical issue. The U.S. has a clear *responsibility* to participate in worldwide conservation activities – both as an example and as a student.

There is wide latitude in what constitutes "conservation" in different world communities. In National Parks and other publicly owned lands of the U.S., we have agreed upon some specifications for conservation. Whether the world community can judge and agree upon specifications for broader areas remains to be seen. But we MUST participate to contribute and to learn.

Bandipur Tiger Preserve *is the setting for this shot of Rosario, the Indian Institute of Science's hired driver.*

Historic Landscape Restoration: Views From 3 Angles

Editor's Note: The following three "generic" looks: sprang from a November 1987 Arid Vegetation Workshop held at Whitman Mission National Historic Site in Walla Walla, Wash., and attended by scientists and resource managers from the NPS Pacific Northwest Region.

By L.L. and P.A. Larson

The process of revegetating land is both a science and an art. The role of science in revegetation is to provide technical knowledge that will assist the land manager in the achievement of a specific goal. Art represents the skill with which this knowledge is implemented in the revegetation process. The purpose of this article is to provide a technical perspective of the blend of science and art by the land manager during the development of a revegetation plan, the selection of species for a revegetation project, and the integration of revegetation techniques.

What is a Revegation Plan?

A revegetation plan represents the framework that the land manager follows during the implementation stage of a revegetation project. It is defined by an interactive process that incorporates three basic steps. First, the plan must have an objective. In the case of most National Historic Sites the objective will be defined in terms of an historic time period, an appearance, and a desired species composition. Secondly the plan must contain a technical assessment of the revegetation potential for the landscape. Landscapes that have been subjected to soil erosion, farming, weed invasion, etc., clearly represent different technical problems than do areas that are in an undisturbed condition. Finally, information derived from steps one and two must be combined, using the technical knowledge and skill of the land manager to form realistic goals with acceptable levels of cost and risk.

Species Selection

The selection of species for the revegetation project has a long-term influence on the success or failure of the project. Ideally the land manager would like to replace the existing vegetation on the park with the native species that occurred at the time of the historic event. However, this may not be an appropriate decision due to ecological as well as logistical limitations.

The ecological condition of a site will determine whether native species should or should not be reintroduced. The land manager must assess the ecological implications of the following questions: 1) Do introduced species currently occupy the historic site? 2) If so, should they be eliminated from the site or are they an important part of the ecosystem? and 3) Can native species compete effectively with the introduced species given the ecological potential and land use of the site?

If introduced species are accepted as part of the ecosystem and are out-competing native species, then species selection for revegetation should emphasize the structure and function of the original plant community rather than restricting the selection to native species. Such a selection will likely result in a mixture of native and introduced species, while maintaining the appearance of the historic vegetation.

The physical and ecological attributes of the selected plant species should be capable of utilizing the resources of the ecosystem to the extent that nondesirable plant species are controlled or eliminated. The species must be suited for the uses that will occur on the land in the future and provide the appearance of the vegetation of the desired time period. The species must be suited to the climatic extremes of the area as well as the more typical growing conditions. Selecting species for these attributes will emphasize community stability and will minimize the need to maintain the community artificially.

The logistical limitation associated with species selection is reflected in the location and availability of plant materials. Basically, two sources of plant materials are available to a land manager. The first involves harvesting seeds from the native plants in the area and replanting them in the area to be revegetated. This method insures that the seeds are from plants adapted to the site, but the method is labor intensive and expensive. The harvest of native seed is viable only during years of good seed production, which may occur once in five or more years. In addition native seed, even in a good year, typically will have lower quantity and quality yield than seed from commercial seed sources. Consequently the use of locally harvested native seed limits the size of the area that can be revegetated annually and increases the risk of seeding failure.

The second source is commercial plant material. This means you are purchasing a plant species strain that has been developed for commercial seed production. These species are developed through a selection process that improves seed production, seed germination, seedling vigor, site adaptation, and in many cases forage production. However, species availability through this source is dependent upon previous commercial development, which historically has favored introduced species over native plants. The number of native species available through commercial seed sources is increasing, but the volume is limited and the cost is high.

The skill with which the land manager integrates the desire to plant native species, the ecological limitation of the site, logistical limitations of seed sources, and a limited budget is critical to the success of the revegetation project. These decisions influence the short-term risk of seeding failure and the long-term likelihood of encroachment by undesirable plant species.

Integration of Revegetation Techniques

Given the fact that most revegetation projects are on limited budgets, it becomes important to minimize the likelihood of seeding failure. The most common reason for seeding failure is inadequate seedbed preparation and competition with undesirable vegetation. A number of factors that lead to seeding failure can be reduced, if not totally controlled, through revegetation techniques. The principal drawback of using these techniques is that seedbed control will usually mean the use of drill rows, herbicides, and tillage. However a skilled land manager can mitigate the physical appearance of drill rows and minimize the need for herbicides by establishing a base vegetation first and then modifying its appearance to achieve the desired pattern and structure of the historic vegetation.

Decisions relating to seedbed preparation and weed control require technical knowledge of the seedbed requirements of the selected species and their ability to compete with specific weed species. Short cuts and the failure to apply technical knowledge in a skillful manner is a prescription for seeding failure.

Conclusions

The lesson in the previous sections is that there are no easy solutions to the problem of revegetating a National Historic Site. Indeed every decision taken by a land manager has a cost and risk associated with it, and most decisions will represent a compromise between ideal solutions, technology, and budgetary restrictions.

Perhaps the most important aspect to this problem is the recognition that we are managing an ecosystem and, by definition, this means seeking a balance between its component parts of climate, topography, soil, and the plant and animal populations. When an

***Power seeder** by John Deere, designed to drill and plant seeds at least 1/4 to one inch underground, is shown here mounted on a flatbed truck. The power seeder, pulled by a tractor, is capable of precise placement of seeds – where you want them and out of the sight of feeding birds.*

***Dr. Larry Larson** describes revegetation strategy to a workshop group of Pacific Northwest Region scientists and resource management specialists.*

***Reed canary grass,** a better competitor than the original rye grass, stands shoulder tall in the reseeded fields of Whitman Mission. While not being the perfect restoration, reed canary grass comes close to establishing the look and feel of the old rye grass meadows that once surrounded Whitman Mission.*

***Untreated field** at Whitman Mission is 80 percent covered by non native species such as pigweed, introduced via hay bales that were used as supplemental feed for cattle. Farming and grazing had occurred over the years on this site.*

ecosystem is in a deteriorated condition it may no longer have the potential to support the historic native vegetation. For example, an historic site that contained a wet meadow may not currently be able to support that type of vegetation due to changes in the water table, loss of the upper soil horizons, or the introduction of a highly competitive weed species. Under these conditions the reconstruction of the original ecosystem potential must occur before the historic vegetation can sustain itself over time.

Unfortunately the high cost of ecosystem reconstruction will put ideal solutions beyond the economic reach of many historic sites. In those situations we should strive to achieve a stable ecosystem that has an appearance similar to the historic vegetation. This may mean that the most viable option is to establish introduced species that are ecologically similar to native species. Then, given time, the established vegetation can be modified to include native species and mitigate the aesthetic cost of using revegetation techniques. Revegetation should be viewed as an iterative process whose first objective is to stabilize the ecosystem, subsequent steps are then taken to establish the desired aesthetic qualities of the overall revegetation objective.

L.L. Larson is an Assistant Professor of Rangeland Resources, Oregon State University; P.A. Larson is a Forester at La Grande, Ore.

Historic Landscape Restoration
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Author's Guidelines for Submissions to *Park Science*

1. Articles should relate specifically to scientific activity within the National Park System or of benefit to the National Park Service in its efforts to plan and manage park resources.
2. Wherever possible, management applications should be described.
3. Park Service management policy is not the subject matter of this bulletin.
4. Authors will be responsible for thoroughly checking all facts.
5. Authors will solicit, prior to submission, review and comment from the superintendent of the subject park(s) and from the Regional Chief Scientist.
6. Major articles can run as long as 1500 words, but should be held to the shortest length possible to tell the complete story.
7. Think "black and white" and send good sharp photos of your subject matter, preferably action in the field wherever possible and appropriate.
8. All copy should be typewritten, double spaced.
9. Revisions will be sent back to you for final approval.
10. Questions as to appropriateness, etc., may go to the editorial board for input.

Continued from page 7

Mission Strives To Deserve Its Indian Name – Waiilatpu

By Dave Herrera, Superintendent
Whitman Mission National Historic Site

When Marcus Whitman came to the Walla Walla Valley he planted, it is said, apple seeds at the site of his newly established mission among the Cayuse Indians. The Cayuse called the area "Waiilatpu," meaning "the place of the rye grass."

Whitman was perhaps the first to plant seeds at Waiilatpu thereby introducing the first non-native plants to the area. Later the Chinese immigrants who worked on the railroad introduced "cheat" grass *(bromus tectorum)* which produces an abundant seed crop and has a shallow root system ideally suited for this semi-arid climate. Farming of course had the most dramatic effect on the native vegetation and the appearance of the landscape. Thus today the rye grass is seldom seen and barely surviving the competition of the exotic weeds and man-made disturbances. The basin wild rye grass *(elymus cinereus),* a tall and beautiful plant with deep roots to tap the subsurface water; once disturbed, finds it extremely difficult to propagate among the hearty annual and perennial weeds. The soil is replete with years of accumulated seeds from the abundant weeds that grew on the mission site grounds.

The mission grounds except for the Whitman gravesite are relatively bare of any historic remnants. During the 50 years of the park's existence, the vegetation in the park was undisturbed and allowed to seek its natural course. Today, we have a sorted collection of some native plants and many non-native plants throughout the 98 acre site. It could remain this way forever. But for several good reasons, the Service has decided to reverse the established trend and attempt to return the native plants to recreate the appearance of the historic period. If we are successful, park visitors and the local populace will praise our agency for giving back this area a glimpse of its history. The park would certainly take on a more historic feeling, inspired by the striking appearance of the tall native grasses. The few historic objects in the park would be richly enhanced by fields of native plants.

Though our goals are admirable and supported by many, the task ahead is a difficult one. This inhospitable climate, which turned for the worst in 1987 by recording a record drought in the Pacific Northwest – this soil, so formidable and the native plants so susceptible to competition – all decree that failure has a greater chance than success.

The risks are many and well known. Disturbing a 10-15 acre plot by removing all vegetation and replanting native species could result in unsightly barren ground and an ideal weed patch. The only chance of success hinges on sheer effort and luck. The techniques are relatively simple; eradicate all standing vegetation and their seeds through burning, apply herbicides, plow and disk, and manually remove the seedheads. The seedbank in the soil also must be irrigated to sprout seeds so that they can be killed, thus removing this source of competition for the native seeds during the coming growing season.

Finding the native plant seeds can be extremely difficult in some cases. Many of the native plants have no commercial value and are not commonly grown by seed farms. Whitman Mission rejected two deliveries before receiving the correct shipment of native seeds.

Assisting in the task of revegetating the mission grounds are the Soil Conservation Service (SCS) and the County Extension Service (CES). Informing the public and other local agencies can result in discovery of valuable sources of information and assistance. Whitman Mission was fortunate to find a highly educated agronomist at the SCS and an entomologist/plant biologist at the CES to work on our project. It seems everyone in this area is an amateur Whitman historian, and both these agency officials are well read on the history of the park. Because of this, they are highly motivated and strongly committed to its success. Both have given valuable information and suggestions to the park staff and to Dr. Larry Larson from Oregon State University the CPSU (NPS Cooperative Park Studies Unit) project coordinator.

Successful completion of the project no doubt will be helped by the expert advise of our consultants who will guide our actions, but the day to day effort must be borne by the park staff. Forming a unity of purpose and action with all park employees directly and indirectly involved in the project is crucial.

It is that unity and resolve, once formed, that will deal effectively with adversity and setbacks that inevitably will occur. In our second year of the project, there have been difficult moments and arduous tasks. Our belief in the project, our vision of its value to future visitors, and the aesthetic value it will have for the park has helped to mobilize our team against the odds. This strong staff commitment to the project becomes the source of ingenuity, creativity, perseverance and excellence in our work.

Despite an initial failure, a record year's visitation, a major drought and other minor setbacks and difficulties and in addition to our normal work, the park staff and our technical advisors have planted approximately 30 acres of ground with a mixture of native plant seed.

Only time will tell the outcome. But if we are successful, our success will give hope and valuable information to other parks striving for the same goal. A field of basin wild rye and other native grasses and plants will stir the imagination of our visitors. People of the region will praise our agency for an outstanding achievement and will feel moved to visit the park more.

And above all, this historic place in Washington's Walla Walla Valley can once again be called – Waiilatpu.

Landscape Architecture Provides Historical Frame

By Cathy Gilbert

Management strategies regarding the treatment of natural vegetation in historic landscapes often focus on techniques for enhancing the historical scene and interpretative environment. Treatments can range from selective thinning of vegetation and vista clearing in overgrown stands to comprehensive reestablishment of native and historic plant communities in disturbed areas. The success of any treatment relies most often on a clear set of management goals for the landscape as a whole, taking into account not only the appearance of the landscape, but the historical context and cultural values of the site, the integrity of the natural landscape, site capacities, park mandates and interpretative opportunities.

In the Pacific Northwest Region an interdisciplinary approach for determining management goals and options for historic landscapes has proven successful. Landscape architects, resource management specialists, scientists, park managers, interpreters and maintenance staff, all provide valuable insight to these complex landscape resources. This interdisciplinary approach, along with a consistent design process for evaluating the cultural landscape, has led to integrated landscape management plans for several historic landscapes in the region. The landscape study conducted at Whitman Mission National Historic Site (WHMI) is a case in point.

Authorized in 1936, WHMI memorializes the work and efforts of Dr. Marcus Whitman and Narcissa Prentis Whitman between the years 1836 and 1847 when they established an Indian mission along the Walla Walla River in the Oregon Territory. The structural complex of the mission originally covered approximately 10 acres with surrounding lands used for crops, irrigation systems and as pasture lands for grazing domestic livestock.

Although no structures remain above ground, the 98.15 acres that comprise the park today include the mission site, monuments, a pioneer and an Indian cemetery and the Whitman gravesite. The historical park also accommodates contemporary NPS facilities including a visitor center, maintenance areas and parking. Altogether WHMI is a landscape that has been highly modified. The result is a mosaic of diverse landscape values, different vegetation types and various levels of contribution to the historic scene. The goal of the interdisciplinary landscape study at WHMI was to identify historic land use patterns and remaining historic plant communities in the park and to develop management strategies for enhancing the cultural landscape. The study team included the park staff and individuals from the PNRO Division of Cultural Resources, Science and Technology and Resource Management. The study had three phases: research; analysis and evaluation; and development of management alternatives.

Site research and investigations into the historical record revealed a considerable amount of information related specifically to the cultural landscape. Historic photographs, maps, drawings, journals and correspondences, all were used to help determine historic plant materials and land use patterns and activities. Understanding how the landscape was used historically and documenting the structures and patterns associated with those uses helped determine the cultural context for the landscape as a whole. Management goals for the landscape were developed based on that context.

***Whitman Mission Historic Site** is it looks today.*

***Whitman Mission in 1847,** from a drawing by S.M. French and titled "Waiilatpu on the morning of the first day of the massacre, showing the departure of Spaulding's pack train."*

In addition, because there were areas of unique character and historic value at WHMI, the team determined early in the project it was appropriate to divide the landscape into six units. The boundaries were based on natural resources – such as topography, soils and water features – and on cultural components – such as roads, paths, fences and contemporary land uses. Organizing the landscape in this manner helped the team understand the historical relationship among several areas and develop specific management treatments for several diverse ecological areas.

At the site itself, inventories and site surveys of existing features and resources were essential for analyzing landscape change and the integrity of remnant plant communities. By comparing the historic record with existing site resources, the team was able to evaluate the historic significance and integrity of each unit, and propose appropriate management alternatives. In addition, the operational and programmatic needs of the park, including maintenance, interpretation, and visitor facilities, also were considered as components fundamental to preservation and visitor experience.

After exploring the history, vegetation patterns and physical character of the landscape and evaluating the historic significance and possible management problems for each area, the land units were placed back into the context of the entire 98.15 acre historic site. Thus, development of management alternatives always occurred in the framework of the park as a whole system, assuring the thematic and material flow from one area to another.

This interdisciplinary approach to vegetation management at WHMI helped everyone involved clarify management goals and strategies for enhancing the historic landscape at the park, integrating the natural and the cultural resource values.

Gilbert is Landscape Architect for the NPS Pacific Northwest Region.

***Editor's Note:** Revegetation of subalpine sites and a montane meadow at Yosemite NP will be discussed in an article by Richard Hadley and Barbara Moritsch in the summer issue.*

revegetation notes

Restoration ecology – bringing back in a few decades what would take nature hundreds of years – is the subject of an article entitled "Tropical Vision," appearing in the February 1988 issue of *Outside* magazine and describing the work in Costa Rica of *Outside's* "1987 Outsider of the Year," Biologist Daniel Janzen.

The site of Janzen's restoration effort is the proposed Guanacaste National Park, 280 square miles of mostly pastureland in a beef-cattle region of Costa Rica – "scrubland today, but tomorrow the park, after a thorough ecological overhaul, will be restored to tropical dry forest, a rare species-rich ecosystem that once covered the boundaries of this park as well as the entire Pacific Coast of Central America."

The article, by Todd Balf, describes Janzen's "completely novel approach," that is "not only saving a major piece of land, but providing a pioneering blueprint to be used elsewhere." The words are a quote from Thomas Eisner, Cornell professor of biology. Michael Robinson, the director of the Smithsonian Institution's National Zoological Park, adds: "I considered his (Janzen's) idea impossible. Obviously I was wrong. He's turned the conservation world upside down."

Janzen is fund-raiser, chief land negotiator, and architect for Guanacaste. The rest of his life, writes Balf, is on hold. The *Outside* article and illustrations explain why Robinson says of Janzen: "He's the Leonardo da Vinci of the tropics. He's worked on everything."

In 1965 Janzen helped found the Organization for Tropical Studies and the prestigious Costa Rican-based field study program, and later he developed the New World's first course in tropical ecology. His books and papers (more than 250) have initiated several "convulsive scientific debates." His topics range from adult beaver-beetles and coral snake-mimics to "Mice, big mammals, and seeds: it matters who defecates what where."

In 1984 he won the equivalent of the Nobel in biology – the Crafoord Prize, for his work in coevolutionary ecology, which focused on how plants adapt to predatory pressure from animals and vice versa.

His recipe for restoration is full of his hallmark sign – controversy. Stop the fires, he said. And allow cattle grazing. Also install special permit areas. Along with land that could not be touched in perpetuity should go soccer fields, campsites, water holes for bathing, and a two-acre, pick-your-own collecting plot on the parkland – to accommodate wealthy tourists who want to buy exotic tropical plants.

"If you can conserve 1,000 square acres by destroying two square acres, you come out on top by 998," Janzen reasons.

Word of this article came from John Tanacredi, Gateway NRA.

meetings of interest

1988

April 20-23, INTERNATIONAL SYMPOSIUM ON VANDALISM: RESEARCH, PREVENTION AND SOCIAL POLICY. Sponsored by USDA Forest Service and the University of Washington Institute for Environmental Studies. Contacts: Dr. Chris Christensen, USFS, Pacific Northwest Research Station, 4043 Roosevelt Way, N.E., Seattle, WA 98105, (206) 442-7846; and Polly Dyer, Institute of Environmental Studies, U of WA, Seattle, WA 98195.

May 16-22, INTERNATIONAL CONFERENCE ON UNGULATE BEHAVIOR AND MANAGEMENT, at Texas A&M, College Station, TX. One-page abstracts due Jan. 1, 1988. Contact for attendance or contributions: Dr. Elizabeth Cary Mungall, 342 Double Tree Drive, Lewisville, TX 75067.

June 6-9, ECOSYSTEM MANAGEMENT: RARE SPECIES AND SIGNIFICANT HABITATS, at State Univ. of NY, Syracuse; in conjunction with the 15th Annual Natural Areas Conference and the 10th Annual Meetings of the Natural Areas Association. Contact: ESF Continuing Education, SUNY College of Env. Sci. and Forestry, Syracuse, NY 13210-2784.

July 5-8, INTERNATIONAL ASSN. FOR IMPACT ASSESSMENT (IAIA) ANNUAL MEETING, at Griffith University, Brisbane, Australia. Meeting theme: "Integrating Impact Assessment in the Planning Process." Contact: Rabel J. Burdge, Institute for Environmental Studies, University of Illinois, 408 S. Goodwin Ave., Urbana, IL 61801; (217) 333-2916.

August 7-11, ELEVENTH NORTH AMERICAN PRAIRIE CONFERENCE, on "Prairie Pioneers: Ecology, History & Culture"; at the University of Nebraska-Lincoln. Abstracts due March 1. Contact: Thomas B. Bragg, 11th NA Prairie Conf., Dept. of Biology, University of Nebraska at Omaha, Omaha, NE 68182-0040; (402) 554-3378.

August 14-18, SOCIETY FOR CONSERVATION BIOLOGY, Second Annual Meeting, to be held jointly with the American Institute of Biological Sciences and the Ecological Society, at the University of California, Davis. Contact Christine Schonewald-Cox, Institute of Ecology, Wickson Hall, U/Cal, Davis, CA 95616; (916) 752-2088.

August 30-September 4, SECOND WORLD CONGRESS ON HERITAGE PRESENTATION AND INTERPRETATION, at University of Warwick, near Coventry England; theme, "Preparing for the 90s." Sponsored by the Centre for Environmental Interpretation (CEI), the Soceity for the Interpretation of Britain's Heritage (SIBH), and in association with the University of Surrey. A Provisional Programme and Registration Form will be available from the Congress Office, Aldine House, 9-15 Aldine St., London W12 8AW. Approximate cost will be 300 pounds, for accommodations and registration.

September 13-15, RESEARCH IN CALIFORNIA'S NATIONAL PARKS, Third Biennial Conference, at U/Cal Davis, for presentation and discussion of research related to the biological, physical, and sociological resources of California's National Parks. Contact: CPSU/Institute of Ecology, U/Cal/Davis, CA 95616; (916) 752-6086.

November 14-18, CONFERENCE ON SCIENCE IN THE PARKS, sponsored by the George Wright Society with the National Park Service and co-chaired by R. Roy Johnson, Leader of the NPS/CPSU at University of Arizona, Tucson, AZ 85721, (602) 762-6501 and James Judge, Director, Fort Burgwin Research Center, P.O. Box 300, Ranchos de Taos, NM 87557, (505) 758-8322.

Raithel Calls for Interpretation Papers

Ken Raithel, Jr., NPS Assistant Director for Interpretation in Washington, D.C., has forwarded a "call for papers" for the Second World Congress on Heritage Presentation and Interpretation, to be held at the University of Warwick, near Coventry, England, Aug. 30-Sept. 4, 1988. Theme of the Congress is "Preparing for the 90s."

Raithel notes that "it is unlikely that a great number of NPS employees can be approved to attend officially," but adds: "We do encourage participation in such conferences and I further encourage Regional Chiefs of Interpretation to approve leave for those employees who wish to make plans to attend on their own."

Wilderness Skills Workshops Slated

The 1988 Wilderness Work Skills program, sponsored by the Student Conservation Association, Inc., opens April 5 with a three-day specialized workshop on trail engineering and design, cross cut saw sharpening and use, and wilderness trail construction and maintenance at Ouachita NF in Arkansas. Six more workshops will be conducted from April through September, in California, New Mexico, Colorado, Virginia and Washington states. Several are comprehensive, covering all subjects; others are specialized. The workshop on sub-alpine site restoration, revegetation, and greenhouse cultivation of native plants will be held at North Cascades in Washington, Aug. 26-28.

Information about dates, tuition, curriculum, and hosts can be had by writing SCA, P.O. Box 31989, Seattle, WA 98103, or phoning (206) 547-7380.

book review

Staking out the terrain: Power differentials among natural resource management agencies by J.N. Clarke and D. McCool. 1985. State University of N.Y. Press. Albany. 189 p.

I ran across this book recently and thought it might be of interest to some of you, particularly those who teach courses that cover agency philosophies.

In it, the authors examine the philosophy, mission, budgets, size, governmental and constituent support, and other intangibles for seven natural resource management agencies. In terms of the above factors, the authors rank the Forest Service and the Army Corps of Engineers as "Bureaucratic Superstars." NPS is lumped with Fish and Wildlife Service and Soil Conservation Service in the middle as "Agencies that Muddle Through." At the low end "Organizational Shooting Stars" one finds Bureau of Land Management and Bureau of Reclamation.

Although the book is somewhat shallow in its analysis, I found the depiction of NPS to be generally accurate, and it made for interesting reading.

R. Gerald Wright, *Ecologist*
Univ. of Idaho NPS/CPSU

Restoring the Earth Meeting 'Sold Out'

Restoring the Earth – a conference described by the *San Francisco Chronical* as "a global movement to *repair* the environmental wreckage wrought by man, not merely to keep it from spreading," took place Jan. 13-16 in Berkeley, Calif., to sold out crowds.

Participants and presenters covered a broad range of topics from the global environmental crises of acid rain, CO_2, and deforestation, to succinct, local how-to-restore-your-nearby-marsh presentations. Industry, government, environmental organizations, and hands-on, grass roots practitioners from across the United States and other nations were present.

Sessions were separated into general and scientific presentations and workshops, permitting attendees to select the level of discussion appropriate to their needs. It was an excellent opportunity to share knowledge, see success stories, and reinforce public awareness of serious environmental problems facing our global community.

The rehabilitation program at Redwood contributed three rehab posters, which were the hit of the Wednesday ice breaker, and two papers presented in a workshop format. We had a full house in spite of playing opposite Alston Chase and several other simultaneous workshops.

John Berger, executive director of Restoring the Earth (1713C Martin Luther King Jr. Way, Berkeley, CA 94709), told the *Chronicle* reporter that the conference "could signal a new phase in the environmental movement, placing restoration efforts alongside resource protection and pollution control. . . . Millions of jobs can be created by restoration work," he said. "When that is fully understood, restoration will spread like wildfire."

Stephen D. Veirs, Jr.
CPSU/UC Unit Leader
Davis, Calif. 95616

Natural Areas Association Boasts Record Attendance at Annual Meeting

By Ron Hiebert

The Natural Areas Association's 14th Annual Meeting was held in Peoria, Ill., on Oct. 13-16, 1987. More than 400 natural area professionals attended, representing 49 states, 4 Canadian provinces, and 6 foreign countries. Participants heard plenary addresses by Glenn Juday, NAA President; William P. Mott, NPS Director; Larry Hensen, Associate Deputy Chief of the U.S. Forest Service; and James R. Thompson, Governor of Illinois. Talks, roundtable discussions, and field trips offered valuable information for natural area and park managers, resource managers, interpreters, and researchers. Program topics included urban natural areas, effects of habitat fragmentation, exotic species, interpretation of natural areas, volunteers, resource planning, international conservation, presettlement vegetation, and inter-agency cooperation. Participants had a choice of 12 field trips and the opportunity to assist in a prescribed burn and exotic plant removal. This is the third year I have attended the annual NAA conference and have found all to be relevant, practical, and enjoyable.

The next annual meeting will be held in conjunction with the State University of New York College of Environmental Science and Forestry in Syracuse, NY on June 6-9, 1988. The conference theme will be "Ecosystem Management; Rare Species and Significant Habitats."

Annual membership in the NAA is $15, which includes a subscription to the *Natural Areas Journal.* Quarterly issues contain articles relating to research or management activities for natural areas, parks, etc.; rare species management; land preservation techniques; theoretical approaches to natural areas work; book reviews; and editorials. A new section appearing in 1988 will facilitate rapid communications among natural area and park professionals. The journal provides valuable and readable information for all park professionals from superintendents to interpreters, from maintenance personnel to researchers. It also provides a forum to communicate research results, new management techniques, or opinions.

For further information on the NAA and its next annual meeting, write to The Natural Areas Association, 320 South Third Street, Rockford, Ill, 61108. For information on the *Natural Areas Journal,* write to the Managing Editor, Holly Wheeler, *Natural Areas Journal,* Holcomb Research Institute, Butler University, Indianapolis, IN 46208.

Hiebert is the Chief, Division of Science, at the Indiana Dunes National Lakeshore.

computer corner

Management Data Manipulation Program

SPECIES and DATAMAN are useful resource management data manipulation programs. They were written by Noel Parlovic and Maria Rodriguez to allow rapid community monitoring data entry and easy data manipulation to formats useful for data analysis and study. Both programs are written in Microsoft Fortran.

SPECIES permits rapid species list creation into an ASCII file, so there is no longer a need to type out full species names with taxonomic authorities. The program requires an initial creation of a list of organisms you use frequently. Interactive entry of eight letter codes creates the desired list. The program comes with full documentation and an example.

DATAMAN converts condensed data matrices into various formats for easy analysis. The input data consist of species abundances at various samples or plots. Such data are sparse and so can be entered as a condensed format which takes less entry time than entering the full matrix with all the zero values. DATAMAN converts such a matrix to full format where each column of the matrix represents abundances of species across many samples. It can also output diversity indices with the full format matrix and convert an unordered condensed matrix into an ordered one. Lastly it will transpose repeated measurement monitoring data into a matrix where each row displays the repeated values of a species sampled at each plot. This allows easy examination of the data for trends over time.

These programs are available for IBM compatibles in versions that run with and/or without a math coprocessor. Full documentation, source code and executable programs are free. Send a blank disk and specify type of computer system to: **Noel B. Pavlovic, Indiana Dunes National Lakeshore, 1100 N. Mineral Springs Rd., Porter, IN 46304. (219) 926-7561, FTS 370-6420.**

Submitted by
Noel B. Pavlovic
and Maria Rodriguez

Automated Catalogs Now Possible

Development of programs on the Regional Library computer management system in the Pacific Northwest Regional Office means we can now begin installing automated catalogs for park collections. Pilot projects are completed for Klondike Gold Rush NHP (Seattle Unit) and John Day Fossil Beds National Monument. Fort Clatsop National Memorial will be the third area to switch to the completely automated management system.

Park benefits include elimination of catalog file cards. The information in them will be stored in the park's computer for instant accessibility, using conventional author, title, and subject. Other major improvements are the ability to search the park's collection, quickly assemble hard-copy bibliographies prior to new research, and access to the Regional Library for compatible-format additional resources.

Parks will continue to receive completely cataloged new accessions, with spine labels and card packets upon request to the Regional Library. Shelf lists will be updated on a routine basis by the Regional Librarian.

The Regional Library, with its completely automated library management system, is making a significant contribution toward development of a Servicewide automated library management system.

Ellen Traxel
PNR Librarian

Reference Database Program

Organize your references using Dbase! The flexibility of dbase II or III allows you to create custom menu-driven programs for reference entry and retrieval tailormade for your operation.

REFS is a menu-driven dbase program, written by Kenneth Cole, which will: 1) Look up articles by author, 2) look up articles using one or more subject keys, 3) edit reference entries, and, 4) output articles to the printer or a computer file. By using REFS, hardcopy library index cards can be maintained by typing a reference only once into the database. Author and subject index cards can be output directly from the database. Because of the flexibility of dbase programming, the printout of references can even be customized.

Because REFS stores the entire reference, (Authors, Title, Journal, Subjects), it is memory intensive, and a hard disk is useful for databases over 600 references. But the advantage of storing all of this into the computer is that subject keys can be written in English rather than codes, and you can produce an alphabetized bibliography for a paper in a few minutes rather than having to look everything up to get all the details (ie. volume, page numbers).

I have run different versions of REFS using Dbase III+ or Dbase II on a DOS system or Dbase II on a CP/M system. For a free copy of the 20K program send a blank disk (specify Dbase and system) to: **Ken Cole, Indiana Dunes National Lakeshore, 1100 N. Mineral Springs Rd., Porter, IN 46304. (219) 926-7561, FTS 370-6419.**

information crossfile

U.S. environmental groups have come up with a new concept for promoting preservation of ecologically valuable land outside the United States: It's called the "debt-for-nature" swap. Bolivia, the first developing country to agree to the plan, will have its foreign debt reduced in return for legal protection of three parcels of land adjoining the existing 334,000-acre Beni Biosphere Reserve – part of it to be maintained undisturbed for research. Another portion will be used by the nomadic Chimane Indians and will be opened to carefully managed agricultural and forestry development.

The $100,000 to finance the swap came from the Frank Weeden Foundation based in San Francisco and was arranged by Conservation International, a Washington-based environmental organization acting through Citicorp Investment Bank. The process is described in the August 7, 1987 issue of *Science*, p. 237-238. Such deals could play a role in protecting habitat for migratory birds that winter in Latin America and summer in the U.S. and Canada.

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Endangered species will be the focus of the September issue of *The Courier*, according to NPS editor Mary Maruca. NPS Associate Director Eugene Hester will author an article on overview and some unanswered policy issues; Ron Lambertson of the USFWS will give a history of the Endangered Species Act; Frances Kennedy of the National Parks and Conservation Association will discuss the NPCA's National Park System Plan as it relates to endangered species; Elaine Joial of The Nature Conservancy will write on preservation of habitat, an article will deal with pertinent data bases, and endangered species also will be treated in an international context. Watch for this one.

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From Margery L. Oldfield, University of Texas Dept. of Zoology, comes word of the March 30-31 Symposium on Traditional Cultures and Conservation of Biological Diversity at Wichita, Kans. Dr. Oldfield has promised a report for the summer issue of this meeting, hosted by the AAAS Southwestern and Rocky Mountain Division and Wichita State University. Raymond Dasmann will keynote the plenary session on March 30; on March 31, biologists, anthropologists, policy analysts, and organizational representatives will give original papers on the prospects and problems of integrating global biological conservation efforts with the rural development needs of traditional cultures.

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Roger Lewin, in his Research News notes in the Dec. 11, 1987 issue of *Science*, discusses the so-called "keystone herbivore hypothesis" as a third explanation for the massive die-off of large mammals during the latter part of the Peistocene (ice age) period – from 2 million to 10,000 years ago.

Climatic change and human predation (overkill) are the two most generally recognized hypotheses for describing the fully 50 percent extinction of large mammalian genera during that icy period. Now comes Norman Owen-Smith of the University of the Witwatersrand, Johannesburg, with a combination of explanations: "once the extinction process has been initiated by the loss of the very large herbivores – those weighing more than 1000 kilograms – the hypotheses seeks to explain the disappearance of other, smaller species. Simply stated, it proposes that the normal feeding habits of very large herbivores, or megaherbivores, have a tremendous impact on the vegetational environment; often, this impact opens up habitats in which smaller herbivores can thrive; if the very large herbivores are removed for whatever reason, vegetation cover will close up, thus eliminating the smaller herbivores too."

The article, titled "Domino Effect Invoked in Ice Age Extinctions," examines the suggestion that the late Pleistocene extinctions differed from earlier episodes where radiation of new species replaced the old because Pleistocene extinctions coincided with human expansion into the continents where extinctions were most dramatic and that these predations could have set off the domino effects that are missing in earlier extinction episodes.

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A 45-page document titled *Guidelines for Preparing Reports for the NPS Air Quality Division*, prepared on contract by AH Technical Services of Fort Collins, Colo., for the National Park Service is available now from the NPS Air Quality Division in Washington, DC.

The *Guidelines* will be used for all contracts and purchasing orders in 1988. It requires an executive summary for each product and that all final reports be submitted in hard copy and on a floppy disk in Word Perfect format. *Guidelines* is available in hard copy or in Word Perfect on a floppy disk. For either format, write Debby Peck, Program Analyst, Air Quality Division, NPS, PO Box 37127, Washington, DC 20013-7127, or call (202) 343-4911.

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An unexpected bleaching of the normally rich brown reef-building corals across a wide swath of the Caribbean is discussed in the Nov. 27, 1987 issue of *Science*. Author Leslie Roberts cites the fears of many Caribbean researchers that this "bleaching" episode – an indication of environmental stress – may herald a profound disruption of the ecology of Atlantic coral reefs, "some of the richest, most productive ecosystems on the planet."

Elevated water temperatures are emerging as the most likely suspect, according to Roberts. For as yet unknown reasons, the corals respond to stress by expelling the algae known as zooxanthellae, which reside in the corals' soft tissues and provide energy and oxygen to the corals in exchange for nutrients derived.

University of Miami scientist Peter Glynn is not optimistic about the chances for Caribbean coral recovery. Three areas devastated by the 1983 El Nino – Costa Rica, Panama, and the Galapagos Islands, "are showing minimum recovery, if any, and that is 4 to 5 years after the disturbance," he said. The Galapagos reefs that were killed by the bleaching now are eroding at a rate of 2.5 to 5 centimeters a year.

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An extensive discussion of the effects of acid rain on freshwater ecosystems appears in the Jan. 8, 1988 issue of *Science* (pp. 149-157). D.W. Schindler, of the Canadian Department of Fisheries' Freshwater Institute (501 University Crescent, Winnipeg, Manitoba RdT 2N6, Canada), finds that acid-vulnerable areas are more numerous and widespread than previously believed. Some invertebrates are disappearing at pH values as high as 6.0, he maintains.

Although lakes and streams in acid-vulnerable areas of northeastern North America have suffered substantial declines in acid-neutralizing capacity, he says, "the recent rate of acidification of lakes is slower than once predicted, in part the result of decreases in sulfur oxide emissions.

The article discusses some of the processes that have contributed to acidification of lakes as well as those that have protected acid-sensitive freshwaters.

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From Anthony Knapp, staff curator in the NPS Washington Office, comes word of a new brochure – "NPS Natural History Collections" – produced as part of its advocacy role by the NPS Natural History Collections Committee. The committee, established in 1985 to advise the chief curator on policy issues and the planning, management, and use of NPS natural history collections, is composed of natural science specialists and curators.

The brochure has not been printed in quantities sufficient for distribution to park visitors, but rather is aimed at NPS employees (to increase their awareness of the nature and value of these collections) and at scientists from outside institutions who have specimen collecting

Conferees Consider Worldwide Effects of Global Warming

The greenhouse effect is no longer a controversial subject for national debate: it is "one of the best-established theories in atmospheric science," according to Stephen H. Schneider of the National Center for Atmospheric Research in Boulder, Colo.

In response to this general recognition, "the largest gathering ever on the subject of adapting to climate change" was held last October in Washington, D.C., and attended by research scientists and a broad array of policy makers representing various levels of government, utilities, car makers, environmental groups, and the chemical, oil and gas industries.

In an article by Laura Tangley in *BioScience* (Vol. 38, No. 1, pp. 14-18), the scientific attention to this phenomenon is described – beginning around the turn of the century when the massive amount of CO_2 being released by the Industrial Revolution were first becoming a cause for worry.

The article traces the accumulation of data and the organized reactions on the part of nations and the world. (CO_2 levels already have increased about 25% since 1900 and are expected to double by the second half of the 21st century. A 1985 conference sponsored by the International Council of Scientific Unions, the World Meteorological Organization, and the United Nations Environment Programme resulted in dire warnings from a distinguished international group of scientists.)

The article details present and anticipated effects on agriculture, forestry, fisheries, and biological diversity and parks. Robert L. Peters of the World Wildlife Fund and the Conservation Foundation contended that an average change of just a few degrees "would create conditions that the natural biota has not had to contend with in 100,000 years."

For consideration of what this could mean to the National Park Service and System, see the editorial in this issue.

permits in parks. A supply has been sent to each regional curator for distribution to NPS staff, including archeological centers and CPSUs.

For additional information on the brochure and the Natural History Collections Committee, contact the Curatorial Services Division at (202) 343-8141 or FTS 343-8141.

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"Case Studies in Protecting Parks" is the title of NPS Natural Resources Report 87-2, issued in December 1987 by the NPS Natural Resources Office in Washington, D.C. The accomplishments of 16 NPS areas in protecting parks from adjacent land and resource development impacts was written by Warren Lee Brown, program analyst with the Division of Planning and Special Studies.

Park managers who have been able to protect their parks' resources are credited with outstanding ability in six key areas:

(1) establishment of clear objectives
(2) anticipation of potential impacts on park values
(3) ability to build support for park interests
(4) understanding of planning and regulatory processes
(5) a talent for compromises consistent with park purposes
(6) effective communication that maintains credibility

Twelve "protection strategies" are described, followed by 16 case studies in which the issues range from commercial and residential development to oil and gas operations, power plants, and dams. The problems include historic preservation, air and water quality, trails and public access.

The illustrated 30-page report is available from Donna O'Leary, editor, NPS Air Quality Division, P.O. Box 25287, Denver, CO 80225-0287.

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From Doug Houston, PNR research biologist stationed at Olympic NP, comes an article from the *Journal of Wildlife Management*, 52(1):162-4, on "Potential of LORAN-C for Wildlife Research Along Coastal Landscapes." Houston calls it "Finding yourself! Literally."

The article, by four U/Rhode Island professors, describes LORAN-C, the electronic system of long range navigation using a network of shore-based radio transmitters that enables mariners with shipboard receivers to locate their position at sea under all weather conditions. It then goes on to cite the documented use of LORAN-C for biological research in marine fisheries and in estimating population trends of the southern pine beetle.

Houston called attention to the value of this system for finding old sampling plots or study locations where changes in vegetation or loss of reference points have made relocation next to impossible. "Attributes of wildlife habitat can also be located by LORAN for future reference or mapping," the authors claim. "Dens or den trees, beaver colonies, genetically interesting seed trees or shrubs, mineral licks, food patches, nest locations, and other landmarks can be plotted on maps within the limits of absolute accuracy."

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For a discussion of the usefulness of a national restoration association (announced in Information Crossfile, *Park Science*, Vol. 8, No. 2, p. 12), see the winter 1987 issue of *Restoration & Management Notes* (5:2, p. 57). John P. Rieger, district biologist with the California Department of Transportation, San Diego Environmental Analysis Branch B (PO Box 85406, San Diego, CA 92138-5406), in a guest editorial, decries the lack of a national organization that serves the field of biological management. He argues that rising interest in, and need for, restoration and the numerous approaches taken, calls for "more dialogue and record keeping" in this rapidly expanding field.

In addition, he says, "there is simply no substitute for one on one communication," and annual meetings would provide the current projects forum that begets such communication.

An additional service of the organization would be to encourage and co-sponsor local or regional meetings that would concentrate on target problems and their solutions. Rieger describes one function as "encouraging the development of a network that would serve the needs of smaller groups."

For an update on the organization of the Society for Ecological Restoration and Management, see p. 17 this issue.

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Paperback copies of the Worldwatch Institute's *State of the World 1988* are available for $9.95 from the Institute, 1776 Massachusetts Ave., N.W., Washington, DC 20036. This is the fifth in a series of "annual physical examinations," checking the earth's vital signs.

"The readings are not reassuring," writes Institute President Lester Brown. "The earth's forests are shrinking, its deserts expanding, and its soils eroding – all at record rates. The ozone layer that protects life from damaging ultraviolet radiation is threatened with depletion, and the temperature of the earth appears to be rising." Government policymakers, corporate planners, professors, and economists are using these reports "to track the environmental changes that are shaping global economic trends."

Dave Graber, NPS Research Scientist at Sequoia/Kings Canyon NPs, discusses the role of research in wilderness in an article appearing in the current issue (Vol. V No. 4) of the George Wright Society's *FORUM*. The article is a summary of Graber's keynote address to the Sierra Nevada Wilderness Managers meeting at Bass Lake, Calif., in September 1987. He concludes that there are three classes of research appropriate in wilderness, and assigns wilderness managers the responsibility for making judgments and then working with researchers to minimize their impacts.

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An update on the National Biological Diversity legislation underway in the Congress headlines the Nov/Dec 1987 issue of the *AIBS Forum*. Congressman James Scheuer's Subcommittee on Natural Resources, Agriculture Research, and Environment (of the House Committee on Science, Space and Technology) has been joined by AIBS Congressional Science Fellow Dr. David Blockstein, who is working with a group of biologists, conservationists and Congressional staffers to prepare more comprehensive legislation than was the original draft.

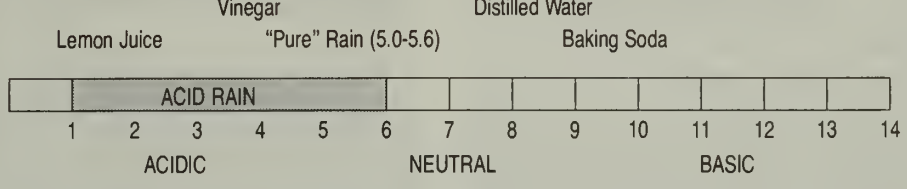
The update observes that the Congressional committee organization, with its "pigeon-holing jurisdictional structure," works against a broad subject such as biological diversity, and the final form may be a package of individual bills.

Elements being considered include (1) a national policy statement toward conservation of biological diversity; (2) management action toward biological conservation; (3) increased coordination, direction, and emphasis on biotic inventories; and (4) support for research in basic and conservation biology.

Dr. Blockstein is soliciting "good ideas regarding the content of the legislation" from biologists, who can contact him at (202) 226-6984.

From *ORION*

How "Acid" Is Acid Rain?



The pH scale ranges from 0 to 14. A value of 7.0 is neutral. Readings below 7.0 are acidic; readings above 7.0 are alkaline. The more pH decreases below 7.0, the more acidity increases.

Because the pH scale is logarithmic, there is a tenfold difference between one number and the one next to it. Therefore, a drop in pH from 6.0 to 5.0 represents a tenfold increase in acidity, while a drop from 6.0 to 4.0 represents a hundredfold increase.

All rain is slightly acidic. Only rain with a pH below 5.0-5.6 is considered "acid rain."

Adapted from: *Acid Rain: An* EPA Journal *Special Supplement, September 1986.*

"Trouble with the Rainbow: Acid Deposition in the National Parks" is the title of an article by Napier Shelton appearing in Winter 1988 issue of the nature quarterly, *Orion*. Replete with full color illustrations, the article describes research currently underway at such NPS sites as Shaver Hollow in Shenandoah NP and what acid deposition nationwide is doing to both the natural and cultural resources of the National Park System. It also describes a mathematical model called MAGIC (Model of Acidification of Groundwater in Catchments) developed by scientists at the University of Virginia. The model uses knowledge about certain important soil processes and can be used to estimate long-term chemical changes that occur in soil, soil water, and surface waters. It has been usefully applied in research on the Rocky Mountain NP watershed, northeastern U.S. lakes, and at various sites in Great Britain, Norway, and elsewhere.

"Assumptions and knowledge about the relations between atmospheric inputs, bedrock type, soil properties, and surface water chemistry are being tested and further refined in watershed studies like those in Shaver Hollow," Shelton writes. "What is learned will be one more foundation stone upon which to build a national strategy for dealing with air pollution and the acid rain it spawns."

regional highlights

Pacific Northwest

"In 50 to 100 years, Paradise Lodge at Mount Rainier will be totally surrounded by forest. The recovery plan for grizzly bears, worked out so diligently in the 1990s, becomes moot, as habitat for the bears is no longer available. Ponderosa pine and Oregon white oak are now the major regenerating species in the lowlands of the northeastern Olympics. These and other changes are *not* predictions of the impending climate changes due to carbon dioxide increases in the atmosphere, but they are possible scenarios based on potential climate changes in the Pacific Northwest."

Thus did NPS Biologist James K. Agee head his Feb. 12 cover letter to superintendents of Mount Rainier, Olympic, North Cascades, and Crater Lake, sent with the article by Jerry W. Leverenz and Deborah J. Lev: "Effects of carbon dioxide-induced climate changes on the natural ranges of six major commercial tree species in the western United States" from Shands and Hoffman's *The Greenhouse Effect, Climate Change, and U.S. Forests*, published by The Conservation Foundation (1987).

The article's value lies in the magnitude of potential physical/biological change and its impacts for park areas such as Paradise meadows, the Hoh Rainforest, and Mount Rainier's winter snowline (up from 2600 to 4900 feet?). Agee suggests that as accurate impact projections become possible, "our confidence levels may rise enough to warrant a workshop or conference on this topic for western or northwestern parks."

* * *

From Gerry Wright at the NPS/CPSU, University of Idaho, comes word of three new publications from what he modestly terms "the prolific writers at the UI CPSU."

Peek, J.M., D. Miquelle, and R.G. Wright. 1987. Are bison exotic in Wrangell St. Elias National Park and Preserve? J. Environ. Manage. 11:149-153.

Jenkins, K.J. and R.G. Wright. 1987. Simulating succession of riparian spruce forests and white-tailed deer carrying capacity in Northwestern Montana. Western J. Applied Forestry. 2:80-83.

Jenkins, K.J. and R.G. Wright. 1987. Dietary niche relationships among cervids relative to snowpack in northwestern Montana. Canadian J. Zoology. 65:1397-1401.

* * *

The same Gerry Wright has organized a symposium for the Second Annual Meeting of the Society for Conservation Biology, to be held jointly with the American Institute of Biological Sciences and the Ecological Society Aug. 14-18, 1988 at U/Cal, Davis. The symposium is intriguingly titled "Long-term conservation of wildlife in national parks: Reality or illusion?" and will consist of six papers, three of whose authors are Doug Houston, J. Varley, and Cliff Martinka. Wright will summarize the symposium for the autumn issue of *Park Science*.

Western Region

An 88-page report (Technical Report No. 28) on *The Small Mammal Community at Pinnacles National Monument*, by Gary M. Fellers and Brian W. Arnold was produced in January 1988 by the Cooperative National Park Resources Studies Unit, U/Cal, Davis. Of the 15 species in nine genera trapped on seven occasions between November 1984 and May 1986, 14 were rodents and one was a shrew. The one non-native (*Mus musculus* or house mouse) was of low density and limited distribution, suggesting it is unlikely to impact on the native mammals.

* * *

Thomas J. Stohlgren (CPSU, Davis) recently co-authored a paper with Sherman Lambert (UCLA) titled: "Giant Sequoia Mortality in Burned and Unburned Stands: Does prescribed burning significantly affect mortality rates?" in the *Journal of Forestry* (February 1988, pages 44-46). They found similar, low levels of giant sequoia mortality in burned *and* unburned stands and no evidence that previous fire scarring has any relationship to tree mortality. The prescribed fire techniques currently being used appear to be a conservative approach to reintroducing the natural role of fire into giant sequoia forests.

* * *

"The Effects of Rock Climbers on the Environment at Pinnacles National Monument, Monterey and San Benito Counties, California," is the title of Technical Report No. 27, available from the NPS Cooperative Resources Studies Unit at U/Cal, Davis. Authors are Catherine M. Genetti and Patricia G. Zenone.

Rocky Mountain

Douglas A. Wilcox, formerly water resource specialist at Indiana Dunes National Lakeshore, is now project leader for Habitat Assessment at the National Fisheries Research Center – Great Lakes, Ann Arbor, Mich. He sends along three recent publications: A Model for Assessing Interdisciplinary Approaches to Wetland Research, *Wetlands*, Vol. 7, 1987, pp. 39-49, A Chronosequence of Aquatic Macrophyte Communities in Dune Ponds, with co-author Howard A. Simonin, *Aquatic Botany*, 28(1987)227-242, and "The role of *Sphagnum fimbriatum* in secondary succession in a road salt impacted bog" with Richard Andrus in *Canadian Journal of Botany* (Vol. 65, No. 11, p. 2270-2275).

* * *

A 75-page publication entitled "The Carrying Capacity of Lake Powell: A Management Analysis of Capacity for Boater Recreation" is now available from Glen Canyon NRA, Arizona/Utah, and the Rocky Mountain Region, 12795 West Alameda Pkwy, P.O. Box 25287, Denver, CO 80225.

Results include the boats-at-one-time limit computed for each zone and a table of boat distribution on the lake by marina of origin, identify the most limiting factor in each zone, and apportion that limit among the several marinas using the boater distribution table.

Mid-Atlantic Region

Mid-Atlantic Resource Management Specialists have been infected with the urge to migrate. Bruce Rodgers, Resource Manager at Assateague Island has accepted a job as Site Manager at Fort Jefferson National Monument; Dave Reynolds, Resource Manager at New River Gorge National River has accepted a job in the International Affairs Office as NPS Representative to the Peace Corps; Pete Baril, Resource Manager at Colonial NHP is trading positions with Chuck Rafkind, Chief Ranger at Richmond NBP. In addition, congratulations to John Apel, Hopewell Furnace NPS, and Rick Potts, Shenandoah NP, for "earning their wings" by completing the recent Resource Management Trainee Program. We also welcome aboard Kathy Jope as our new Regional Natural Resource Manager. Good luck to all in their new positions!

Twenty-three Resource Managers from the Mid-Atlantic Region recently completed a Region-sponsored course on learning DBASE III for use with resource inventory and monitoring databases. Participants used self-paced instruction modules on individual microcomputers in a lab made available by Pennsylvania State University. As a final assignment, participants spent the last day developing DBASE applications for a database from their respective parks. Copies of the DBASE Instruction Manual are available from Jeff Marion, Star Route 38, Milford, PA 18337 (include a blank floppy disk as several files are also needed).

* * *

A two-year study of the federally-listed piping plover at Assateague Island, conducted by researchers from Virginia Polytechnic Institute, provides information on piping plover population size, breeding chronology, and natural and anthropogenic factors affecting nest success. Most documented nest failures were attributable to predation by red fox and raccoon; only one was directly attributable to human activity.

* * *

Two endangered species have found new homes at New River Gorge NR. A pair of falcons were released in a new peregrine hacking program, a cooperative effort between the West Virginia DNR, the Peregrine Fund, the NPS, the USFWS, and a private landowner. A federally listed plan species, *Trifolium stoloniferum* (running buffalo clover) also was successfully reintroduced. The species was last collected in the 1940s and was thought to be extinct until a West Virginia botanist discovered it in 1983 along the New River just outside the park boundary. Cuttings from those plants were propagated and used for the reintroductions.

Water Resources Division

Ray Herrmann, a member of the Katmai Scientific Experiments Panel of the Science Advisory Committee for the Deep Observation and Sampling of the Earth's Continental Crust program (DOSEC) has participated in review of the Katmai research proposal, to insure a sound scientific plan that will minimize environmental concerns. The science proposal, prepared by 49 co-investigators, has passed muster, but the environmental soundness of the proposal has yet to be determined. Several legal questions remain as to the relative priorities of geological research and wilderness at Katmai, and the Alaska Region is initiating an EIS on the matter.

Alaska Region

From Al Lovaas, Regional Chief Scientist, comes a speech given last summer by Chip Dennerlein, then director of the Alaska Division of State Parks, to the 20th Annual Federal and Provincial Parks Conference in Canada. In it, Dennerlein makes a pursuasive case for "managing" wilderness, so that a sense of freedom and of pristine setting is available to both the conventional tourist and the backpacker ... a neat trick.

"The visitor to a remote park is often looking for absolutes, not degrees of an experience," Dennerlein writes. "Management is by definition a science of degrees. Standing on that paradox is not an easy job." He contends that "the home of the bears and the raw untouched realm of the glaciers must start at the edge of the road, at the end of the trail, at the fringe of the campground and on the other side of the pane of glass in the visitor center window," as sharply and crisply "as the fold of a piece of paper."

Dennerlein's paper will appear in a future issue of the George Wright Society's *FORUM*.

gis notes

GIS Plans

If you are planning to build a GIS data base and use GIS technology in your park, the best way to anticipate and plan for your needs and requirements is by preparing a GIS plan. There are no formal guidelines for preparing this document, but here are some suggestions on what it should address:

1. What resource, maintenance, operations, or other management problems will the GIS help solve? In other words, what are the intended applications of the GIS?

2. What data, at what scales, will be needed in the GIS to address the problems cited above?

3. What data does the park already possess? What form are these data in (e.g., maps, tables, digital, etc.)? What is the scale of the maps? What text data bases exist that could be used in conjunction with the GIS?

4. What data does the park need to acquire? How will this be done? What are sources of additional data? How much will data acquisition cost? What is the schedule for data acquisition?

5. How will the digitizing of data be done? How much will the digitizing cost? What is the schedule for digitizing?

6. What GIS software will be used?

7. What are the alternatives for running the GIS? How much will they cost? What hardware acquisition is proposed? What is the schedule for hardware acquisition?

8. Who will operate and use the GIS? Where will the system administratively reside? How much time will the park devote to using the GIS?

9. How does the creation and use of the GIS data base relate to other data management activities in the park? Is it part of a wider effort to coordinate and consolidate all data management activities throughout the park?

Circulate the draft GIS plan throughout the park – to all divisions. This will serve to bring everybody in on the process, and minimize conflicts and misunderstandings along the way.

Note: Parks with GIS plans include Yosemite, Sequoia/Kings Canyon, George Washington Memorial Parkway, and Rocky Mountain.

Status Update: GIS Capabilities and Data Bases

List 1. Parks with GIS data bases ready for use: Acadia, Antietam, Big South Fork, Big Thicket, Big Bend, Cape Cod, Capitol Reef, Death Valley, Denali, Everglades, Glacier, Great Smoky Mountains, Lake Mead, Minute Man, Morristown, Mount Rainier, North Cascades, Obed, Olympic, Prince William, Redwood, Santa Monica Mountains, Saratoga, Shenandoah, Wrangells/St. Elias, Yellowstone, Yosemite.

List 2. Parks with GIS data bases under construction: Big Cypress, George Washington Memorial Parkway, Great Basin, Richmond.

List 3. Parks and related units with *onsite* operational GIS capabilities (i.e., hardware in hand to conduct onsite, standalone GIS activities; this list excludes parks with strictly CAD or display capabilities): Antietam, Big South Fork, Biscayne, Bryce Canyon, Capitol Reef, Everglades, Glen Canyon, Gulf Islands, Indiana Dunes, Mount Ranier, Obed, Redwood, Santa Monica Mountains, Shenandoah, Southeast Archeological Center, Yosemite.

List 4. Parks and related units *in the process* of acquiring operational onsite GIS capabilities: Big Cypress, Canyonlands, Death Valley, George Washington Memorial Parkway, Grand Tetons, Gulf Islands, Indiana Dunes, Richmond, Sequoia/Kings Canyon, Yellowstone.

If you're not on one of these lists – and you feel you should be – or you're not on the right list, or your situation is just plain misrepresented, drop me a note or simply call (FTS 327-2593, 303-969-2593) to correct matters. Also, don't forget the open invitation to send in comments and articles about your GIS activities.

Equipment Notes

The DOI GIS Peripherals Contracts (Winter '88, p. 21) have been amended. Significant changes include:

1. Replacing the Pericom MX7100 low resolution color terminal with the Pericom MX7200 medium resolution color terminal. Price: $2850;

2. Replacing the Tektronix high resolution color terminal with a high resolution color UNIX workstation. Price: $18,765. This device is a high-performance standalone computer capable of running both SAGIS, GRASS, *and* MS/DOS applications.

There are now two hardware paths to GIS processing: the UNIX-enhanced AT, on the one hand, and the integrated workstation, on the other. The UNIX-enhanced AT consists of a standard 80286-based AT and a UNIX processor, which runs the GIS software. The graphics terminal is separate and serially driven. The workstation consists of an integral UNIX processor connected directly to a graphics display device. Feel free to call me for specifics (303-969-2593; FTS 327-2593).

Harvey Fleet, *Chief*
Digital Cartography Branch
GIS Division, NPS Denver

mab notes

The projected FY1988 budget of the U.S. MAB Program is $940,000 (up from $650,000 in FY1987). Of the eight agencies expected to contribute, five had already obligated funds as of November 1987. More than half of the budget is earmarked for symposia and new research.

Symposium Proposals. The MAB-8 Directorate reviewed two symposium proposals at their February meeting. One, developed by G. Carleton Ray and Bill Gregg, deals with application of the biosphere reserve concept to management of Mid- and South Atlantic coastal barriers. The Directorate endorsed this proposal and forwarded it to the U.S. MAB Executive Committee for a decision on funding. The other is a bi-national symposium and workshop on use of biosphere reserves (namely, Big Bend in the U.S. and Mapimi in Mexico) in addressing the conservation of biological diversity in the Chihuahuan Desert. This symposium might become part of the Third Chihuahuan Desert Symposium, scheduled to be held at Sul Ross University in Alpine, Texas, in November 1988. The Directorate expressed interest in the proposal but deferred recommendation until the Mexican National MAB Committee has provided their comments.

Research Proposals. The Executive Committee's decisions on research proposals to be funded wholly or in part through the MAB-8 directorate are expected in May. Three look like especially strong candidates at this time.

1) Southern Appalachian Pilot Project. Funding would help establish and conduct work through a MAB cooperative including several regional institutions and the existing Coweeta and Great Smokies Biosphere Reserves. Potential components of the Southern Appalachian project include implementation of the Smithsonian/MAB biodiversity program on collection and monitoring; ecological comparison of pristine and human-impacted sites; a publication on ecological guidelines for economic development in the region; and implementation of the MAB Ecosystem Conservation Database in the Southern Appalachians.

2) Integrated Research on Effects of Global Change in Northwest Alaska. Charles Slaughter, Institute of Northern Forestry in cooperation with Bruce Wiersma. This study would examine climatological changes in the forest-tundra ecotone, probably focusing on a trans-Alaska transect from the coast inland, with a "biosphere observatory" in Noatak Biosphere Reserve. This would tie in with the International Geosphere-Biosphere Program. MAB-6 (Arctic) would be the lead directorate, with participation also of MAB-14 (Pollution), as well as MAB-8.

3) Caribbean Pilot Project. Allen Putney, Eastern Caribbean Natural Areas Program. This project, focused on the Virgin Islands Biosphere Reserve, would emphasize ecosystem rehabilitation and sustainable resource use in areas adjacent to Virgin Islands NP, building on the 4-year MAB research program in the Virgin Islands that is now winding down. It would complement a Unesco and UNEP biosphere reserve development project in the Lesser Antilles, of which the Virgin Islands are a part.

Ecosystem Conservation Database. This project, directed by Wilson Crumpacker of the University of Colorado, has completed several assessments of the adequacy of protection of U.S. ecosystem types, using computer analysis of map overlays of national classifications of potential natural vegetation, ecoregions, and physiography. Four reports are due for publication this year: a preliminary assessment for Federal and Indian lands (accepted in *Conservation Biology*); a comparative assessment of ecosystem representation in the National Park System and other U.S. land management systems (to be published by the National Parks and Conservation Association); a description of project goals, history, and accomplishments (in the forthcoming proceedings of the biosphere reserve symposium at the World Wilderness Congress); and an assessment of potential natural vegetation types on Federal and Indian lands in particular ecoregions, including information on individual states. A more comprehensive assessment of ecosystem diversity and protection status is being conducted for areas in Florida larger than 5000 acres.

Brochure Out at Last! The international brochure on biosphere reserves that was at least three years in the making came off the press in February. We are very pleased with the high quality of reproduction. Prepared by the National Park Service and a contract designer and printed with funds from Unesco, the fold-out brochure explains biosphere reserves on one side and has a map of biomes and reserve locations on the other. Copies will be sent to all biosphere reserve parks, and requests from other sources will be answered as long as our supply holds out. Write or phone Bill Gregg (202-343-8122) or myself (202-343-8136).

Napier Shelton
NPS Washington Office

Interpretation

A New Yellowstone Curriculum

By Jack de Golia

Yellowstone National Park is now offering a curriculum for upper elementary grades. Called **Expedition: Yellowstone!**, it's available to help teachers and students study Yellowstone. Students are able to learn about the park either by studying it at their school or by combining classroom work with a trip (an "Expedition!") to Yellowstone.

The program allows the park to explain current policies to audiences of local students and their adult chaperones. Interest in the program is highest in the states surrounding Yellowstone: Montana, Wyoming, Idaho, and Utah. These are also the areas with intense interest in park management policies. But teachers from all over the country have purchased the materials to use in their classrooms, allowing the park to spread the word about Yellowstone specifically and national parks in general, far and wide.

Aimed at the 4th, 5th, and 6th grade levels, the curriculum materials consist of a teacher's workbook and a storybook, the latter entitled, *Expedition Yellowstone, A Mountain Adventure.* The story book was published last summer. It has original stories about the park, each about one of the major concepts in the accompanying teacher's workbook. The workbook can be used to teach mathematics, science, social studies, and language arts.

Teachers registering to participate in the program also receive logistical information for planning an "Expedition" to the park. They may reserve accommodations and are assigned a park ranger to help them plan and prepare their "Expedition." The accommodations are rustic cabins at the Lamar Buffalo Ranch in the northeastern part of Yellowstone.

During these Expeditions, park interpreters take groups on all-day hikes and walks to study concepts in the curriculum materials. It's during these extended contacts that students and parents can learn about park management. Interpreters stress the uniqueness of national parks, how they're managed in special ways, and how national parks require special behavior from people enjoying them.

Participants can also hear about and see resource management practices. As a group passes an exclosure, the interpreter uses the opportunity to tell students about long-term study of the park and how that knowledge is used by park managers. The students themselves then get a chance to learn first hand about resource management as they conduct simple plant transects surveys. These surveys increase their awareness of their surroundings and also introduce standard resource management practices.

The Expedition Yellowstone Program is allowing the Park Service to reach the next generation of citizens with the message about national parks, ensuring they will care for the legacy of national parks the current generation received from its predecessors.

de Golia is a Park Ranger, Division of Interpretation, at Yellowstone NP.

***Ranger Jack de Golia** and students explore a wilderness thermal basin in the remote Lamar Valley of Yellowstone NP. (Photo by Dave Price)*

Biological Diversity Interpretation Planning Underway

NPS Director Mott decided that biological diversity will be the Servicewide interpretive theme in 1989, and the first major step to make that happen has been taken. At Harpers Ferry, W.V., Jan. 20-22, a committee chaired by Dick Cunningham, Western Region Chief of Interpretation, planned a program of biological diversity interpretation.

The committee reflected the breadth and many dimensions of the issue. It was composed of park, Regional, and Washington office interpreters; representatives from Natural Resources, WASO, and the Harpers Ferry Center; a park resource management specialist; an environmental education expert from Ohio State University; three non-NPS scientists, including two from the 1986 Task Force on Biological Diversity; and representatives from the Smithsonian Institution, USDA Forest Service, and U.S. Fish and Wildlife Service.

The goal of the program, it was decided, will be to "foster public understanding of the value and means of conserving biological diversity." Among the many ideas discussed were a manual for interpreters containing background information and interpretive activities; a central slide repository on biological diversity; and purchase of sets of the Smithsonian traveling exhibit on biodiversity, to which an NPS panel could be added. A coordinating committee on interpretation of biological diversity, consisting of representatives of several governmental and private organizations, was also suggested. An NPS brochure for the public is already in second draft.

Cunningham expects to have the plan in final form by April, and an article on the plan will appear in the summer issue of *Park Science.*

Napier Shelton

Ungulate Behavior Conference Honors Dr. Walther

David Manski, NPS Natural Resource Specialist at Katmai NP and Preserve, is co-chairman for the International Conference on Ungulate Behavior and Management to be held May 16-22, 1988 at Texas A&M. The conference is a follow-up to a 1971 symposium held in Calgary, Canada, on the behavior of ungulates and its relation to management (published by IUCN in two volumes edited by Drs. V. Geist and Fritz Walther.

The conference is being organized as a tribute to Dr. Walther, now retired, "whose life work and professional devotion have centered on ungulates."

Southern Pine Beetle Management At Hot Springs National Park

By Neil Korsmo

The southern pine beetle (SPB), *Drendroctonus frontalis* zimmerman, one of more than 12 American species of *Dendroctonus*, is a primary bark beetle pest, which attacks coniferous tree species throughout its range. It is capable of rapidly building up population levels to epidemic proportions in forested areas occupied by its preferred hosts, shortleaf and loblolly pines. Attacking adult beetles bore through the bark and construct S-shaped egg galleries in the cambium layer. Developing larvae feed on the cambium and then pupate in the bark. The girdling of the cambium, and the introduction of blue stain fungus by southern pine beetles always results in death of the tree.

Researchers have identified conditions that may influence susceptibility of coniferous trees to southern pine beetle infestation: drought or flooding conditions, mild winters, over-mature trees, unfavorable soil-moisture relationships, dense stands of mature pines (versus mixed pine-hardwood stands), lack of fire, lightning, and mechanical injury. The lands within the boundaries of the park have experienced all of these conditions in the past, and will continue to experience most.

In the spring of 1986, several infestations of southern pine beetles were found near Hot Springs, Ark., in Garland County. Initial inspection of the park in July of 1986 by Arkansas Forestry Commission personnel, U.S. Forest Service (USFS) entomologists, and NPS Rangers identified 14 sites with over 550 infested and dead trees. Hot temperatures and lack of rain contributed to a rapid increase in the number of infested trees. USFS computer projections of SPB growth for these sites indicated that from 3,000 to 5,000 trees would be affected by the fall of 1986 if no control action were taken.

Park personnel researched available data from the USFS, and from other NPS areas on the SPB problem, and on control measures available to meet the problem. A Southern Pine Beetle Management Plan was prepared by park personnel and approved by the NPS Southwest Regional Office for action during the summer and fall of 1986. Control of the infestation was necessary to prevent the southern pine beetles from moving out of the park lands and into nearby commercial and residential pine stands.

The USFS provided the park with emergency funds to purchase equipment and supplies to be used in the control effort. All control activities would be guided by the criteria outlined in the 1982 NPS Management Policies. The control action decided upon was that of cut-and-leave, since it could be applied quickly by a two or three person crew with minimal cost, was the least disruptive to the environment, avoided using toxic chemicals, and would disrupt the advance of the southern pine beetles to other pines. Nutrients are returned to the soil, and an increase in the natural predators of the southern pine beetle has been found in areas where this technique had been applied.

The cut-and-leave technique of direct control was decided upon as a spot disruption measure. Continued site growth requires three factors: emerging beetles, nearby pine trees, and a source of secondary attractants. Cutting the most recently attacked trees on the edge of the site eliminates the attractant source, the dropped trees in the buffer strip eliminate nearby pine trees, and beetles emerging from infested trees tend to disperse in the absence of attractant.

Aerial and ground monitoring were conducted to locate suspected infestation sites. After determining the direction of the infestation movement at the site, ranger personnel marked the last infested trees at the site and also marked a buffer of uninfested trees at each site. The buffer was essentially in the shape of a half moon, and extended a distance of about 50 to 100 feet beyond the last infested tree in the direction of spread of the infestation ... a distance recommended by USFS researchers.

All the marked trees were then cut, being sure that all the cut trees fell toward the center of the infested site. Some of the active sites were treated by only cutting the last infested trees, and not cutting a buffer strip of uninfested trees. This technique was tried in an attempt to save as many as possible of the pine trees that were not infested.

Very close monitoring of the sites was conducted to see if retreatment was necessary. One site treated using this technique required cutting of new infested trees four additional times before going inactive. Other sites were left to develop and/or die on their own as an experiment in control techniques. All sites treated in this manner went inactive on their own.

As the temperatures cooled in September, the SPB activity stopped. A total of 832 pines were infested during the 1986 season, and a total of 361 pines were cut during control activities. Results of the 1986 season indicated that there was no way to predict which sites would continue to grow and/or die without treatment, or how large of a buffer strip would be adequate to stop the spread of the infestation at a site.

Hot Springs NP, and all of Arkansas experienced a comparatively mild 1986 - 1987 winter. Based on that fact, and information gathered about SPB activity, it was predicted that 1987 could be a year of greater infestation and tree destruction. The USFS again provided funds, and training for the park staff on how to identify and control the southern pine beetle. The park was able to hire two seasonal employees devoted exclusively to SPB control efforts. A Youth Conservation Corps (YCC) enrollee also worked on the project this year.

Initially, the SPB crew was involved with the cutting of dead, hazard trees at the SPB sites of 1986. The crew also conducted a regular, and extensive monitoring of the park lands to spot, locate, and identify suspected SPB sites. Many SPB sites from the previous year that had gone undetected, but were now inactive, were found and documented. In June, as the hot weather settled in for the summer, anticipation ran high that there would be a large outbreak soon. In July, the new infestations began to appear, with the pine needles fading to yellow and red in numerous small spots in all sections of the park.

In all, 37 sites were identified in 1987. Almost all the spots were very small, some with only one or two trees infested. Most of these sites were allowed to develop without treatment, and all the untreated sites went inactive without control measures being taken. Two new sites became quite large, and the cut-and-leave control technique using buffers was initiated on those sites. One of the two sites presented a difficult control problem. The beetles managed to get past the original 50 foot buffer, and continued to infest more pines. A second buffer of a 100 foot width was cut to attempt to halt the spread. The

The Southern Pine Beetle

beetles then went around the end of the buffer in a completely different direction. Another 50 foot buffer was cut to stop the spread in the new direction. Due to the control problems at this site, it was decided to cut a 50 foot buffer completely around the uncontrolled portions of the site. This site has now gone inactive. All sites found during 1987 have gone inactive as of October.

A total of 385 pines were infested during 1987, and 360 pines were cut during the control activities undertaken this year. The southern pine beetle has infested trees on 45 acres of park land during 1986 and 1987. Through our control activities, we have prevented the spread of the beetle to adjacent commercial and residential pine stands.

Researchers are no closer to determining why the SPB sites grow and then become inactive with or without treatment. If the winter of 1987 proves to be as mild as last winter, it is anticipated that 1988 will be another year of numerous infestations. Control measures will be taken based on what has been learned during the past two years of experience, and on any new information supplied by the U.S. Forest Service.

Korsmo is a Ranger at Hot Springs NP, Arkansas.

A Working Society

The Society for Ecological Restoration and Management, "a working society on the move for you," was formed in November 1987 and has established a board of professionals from across the nation. The board will be steering the society through the business process towards its annual meeting in Oakland, Calif., Jan. 16-20, 1989.

The Society's purpose will be to promote research, encourage communication, raise public awareness of the value and limitations of restoration, and solicit support for restoration and related research.

Plans have been developed to provide member services, including creation of a directory of restorationists and one for projects being developed. New members will be receiving a questionnaire for the first directory.

Dr. Bill Halvorson, NPS, Dr. Bertin Anderson, ASU, Dr. Bill Jordan III, U of WI and John Rieger, Calif. DOT, are currently developing the technical sessions for upcoming meeting in January.

For further information write Society for Ecological Restoration and Management, 1207 Seminole Highway, Madison, WI 53711 or call John Rieger (619) 237-6754 or Bill Jordan (608) 263-7889.

Parks Without Boundaries Pose Strategic Management Challenge

By Malcolm Ross, Jr.

During the past several months I have been trying to put together an article for *Park Science* detailing the unusual management approach used at the Upper Delaware Scenic and Recreational River for the past eight years. Just as I completed my effort, I found an excellent article in the winter issue of *Park Science* entitled; "Strategic Management Needed to Maximize Park Resources" by Everglades NP Asst. Supt. Robert L. Arnberger. The need for and value of "Strategic Management" philosophies are being incorporated successfully into the Upper Delaware implementation effort, but it took a great deal of trial and error to adapt to a new way of doing business with the public as an equal partner.

The Upper Delaware Scenic and Recreational River is what could be accurately called the razor's edge of new management concepts for public recreational needs. Instead of large scale land acquisition with one management authority and well defined agency generated objectives, we have been designing our management strategy in concert with the 15 towns and townships, 5 counties, 2 states, 9 federal agencies, and an interstate compact, all of whom have some responsibility for resource issues affecting our area of concern.

The demand for water oriented public recreation on the Upper Delaware River has been climbing steadily since the early '70s. Located a short two hour drive from New York City, the area provides an excellent opportunity for city oriented visitors to experience and soak up the out-of-doors that we who live in the parks treasure for most of our lives. Our identification as an agency, along with our management role, is primarily relegated to river interpretation and public safety associated with river recreation. However, in that role we have developed a methodology for teaching urban dwellers to value the resource, to recreate safely, and most of all to understand that we don't own the land and private property rights must be respected. That's a tough job requiring innovative thinking when 80 percent of our water oriented users access the river through one of over 30 private commercial livery operations.

The 1978 legislation that created the Upper Delaware as a unit of the National Wild and Scenic Rivers System, spelled out our interim authority and responsibility to develop a program to manage public recreation on the river. It even contained a somewhat revolutionary method to provide funding for contracting with local governments to hire people who would provide trash collection and law enforcement coverage in the river corridor. Only 6 of 15 local governments had an organized police force in 1980 and only two were fulltime programs. This effort to get local towns to manage these functions within their own jurisdiction became the initial strength of the interagency management concept envisioned by Congress and the local citizens who fought for the legislation in the '70s.

The ultimate strategy describing just how the interagency management effort was to function was not in our 1978 enabling legislation. Congress simply said to the National Park Service: You will be the lead agency for developing this new approach. We want you to develop a River Management Plan with full participation by all affected residents and governmental entities found within a 73.4 mile designated section of the Upper Delaware River between Hancock and Sparrowbush, N.Y.

NPS jurisdiction would be restricted to the surface of the Upper Delaware River and any lands purchased for administrative or public use needs. In addition, the use of condemnation for land acquisition was severely restricted both in acreage and justification that would trigger such action. Condemnation could be justified only for threats to the resource that were causing a significant impact on the intent of the National Wild and Scenic River Act. The final boundary would be determined as part of the inter-agency effort to create an acceptable river management Plan. Here the Park Boundary designates the **area of federal interest** for monitoring land management issues affecting the river.

Public acceptance of this new concept was, shall we say, less than unanimous. Many of the local residents were all too aware of the land acquisition furor that had occurred at the Delaware Water Gap NRA, our sister area a short three miles downstream from the terminus of the Upper Delaware River designation. Over 600 homes had been purchased under both willing buyer and adverse condemnation procedures. The presence of land condemnation authority in our enabling act was not palatable to many local residents. Fears ran high that the same buyout concept would prevail at the Upper Delaware, regardless of our unrelenting assurances that this time it would be different.

How then does one manage a river resource when one has no jurisdiction over the land that affects it? There is adequate authority and expertise all around but finding ways to identify and communicate with the proper officials to get action on river concerns was not spelled out in any NPS handbook. It was necessary to identify all agencies having some form of administrative responsibility for the area and the particular bureau, office, department, and individual who had the responsibility for responding to toxic pollution, sewage control, mining, or other such serious resource impacts on both sides of the river.

With a lot of help, I put together a "Resource Impacts Directory" identifying all of the key contacts, and distributed it to all those listed so that they could get to know each other as well as the NPS. Our directory contains over 200 names and it grows each year, with revisions identified through the interaction process. Because we work fulltime at coordinating issues, we have become the monitoring agency for a labyrinth of political boundaries. Every newspaper that circulates within the corridor is monitored for all pertinent resource issues, zoning actions, new development, or any other action that affects the area, either positively or negatively.

Each of the 15 towns/townships that border the river is a strong advocate of self determination with no love for outside intereference. Some towns had fairly good zoning in the late '70s, however, most of the rural independent residents viewed land use planning as unnecessary; they knew and trusted their neighbors. I was once told at a public planning meeting; "we don't need zoning here. Why, we don't even need stop signs, the cows can't read umm." Our challenge was, and still is, to convince those who had taken very good care of the area in the past that the demand for seasonal housing would soon be a problem for every river edge community. When we set up shop on the edge of the river in 1979, only 6 towns had zoning. Today 11 local governments have a complete zoning ordinance and the others are looking hard at the need for land management planning.

What makes resource management or any other part of park management difficult on the Upper Delaware is convincing people of the need for land use regulation when you have very limited legal authority to back up the need. It's a little like going on road patrol as a ranger without all the normal signs of authority like a uniform, identification, or a marked patrol car. Your best and most effective approach is your ability to convince those affected that you are willing to listen and to see the issues from their point of view. Folks need to know you as a person first and a federal employee second. How they see you as a person will directly influence their willingness to listen to your ideas.

Fear of federal dominance in the Upper Delaware Valley has created misinformation and misconceptions about NPS intent. In many parks one can dictate management direction with a minimum of dissent and strong control of the outcome. Shifting gears to where park managers must first convince others of their goals, especially when those affected can simply say no, takes conviction, talent, and commitment to the concept.

The basic land use struggle that created the Upper Delaware legislation, and required an eight year effort to define how it would be applied, is that of private property rights versus public use. This is an experiment as to whether the Delaware River, a national treasure, can be protected sufficiently under a partnership agreement rather than through total federal dominance of the process. It requires trust, patience, and perseverance from all parties. We seem to be beginning at last to build the trust that some day will overcome skepticism expressed by the public when told: "I'm from the federal government and I'm here to help you."

Ross is Resource Management Specialist, Upper Delaware Scenic and Recreational River.

ipm notes

The NPS Integrated Pest Management (IPM) Program participated in a World Bank seminar on IPM and Biological Controls in Agriculture on Nov. 19, 1987 in Washington, DC. Participants included environmental and agricultural specialists from the World Bank, the EPA, the USFWS, AID, the UN, and a contingent of farmers, scientists and business representatives from Massachusetts. The objective was to introduce some IPM strategies to farmers in developing nations, where the use of agricultural chemicals often is heavier than needed.

Highlights included a panel led by Massachusetts Food and Agriculture Commissioner August Schumacher, Jr., U/Mass biological control and IPM researchers William Coli, Roy Van Driesche and David Ferro, and three farmers who have substantially reduced their use of pesticides by turning to safer, cheaper and more effective IPM control strategies.

To illustrate the use of IPM to save money, Coli cited the following example: Based on the 1986 dollar, a series of case studies of 9 crops in 15 states showed a $579 million total change per annum in net returns for IPM users over non users. Interestingly, the total USDA IPM outlay at the time of the study was only $7.5 million for all crops in the entire U.S. ... a healthy return on investment!

NPS's Environmental Assessment (EA) on the Servicewide IPM program is in the early stages of preparation, and a notice soliciting public comments on the scope of the EA has been sent to the Federal Register. The Service last published an EA on this subject in 1977. New data and changes in regulations and techniques concerning NPS pesticide uses necessitate a program reassessment.

Donna Vermeire
IPM Training Coordinator, WASO

Managing Butterflies In Urban Environments

By Don Riepe and John T. Tanacredi, Gateway N.R.A.

Management of insect species at most parks is limited to the development and implementation of pest control policies and integrated pest management plans (IPMs). Often overlooked, or underemphasized in faunal communities, butterflies, moths and other beneficial insect species often times play a larger role in ecosystems than some of the more conspicuous macrofauna such as birds and mammals. As pollinators, soil builders, decomposers and environmental quality indicators, insects and other invertebrates perform major functions of the system.

Park managers, desirous of obtaining a more complete ecological perspective in their resource management, should consider the invertebrates in their long term planning. Many species of lepidoptera, for example, are restricted to one or a few species of host plants for larval development. Some species are very localized in occurrence and/or fly only two or three weeks a year. Failure to inventory and incorporate these insects into management actions may lead to their extirpation from park habitats.

Insects are a form of wildlife. Butterflies add color, form and movement to an environment. Public attitudinal studies toward wildlife have given highly favorable ratings for butterflies (Riepe, 1979). In urban parks, where only small natural sites exist, insects may be the major wildlife group for interpreters to use in developing environmental education programs. The fact that butterflies, beetles, grasshoppers, etc. forage, nectar and carry out life cycles at or near ground level makes them ideal subjects for school children to focus on.

At Gateway's Jamaica Bay Wildlife Refuge, several areas have been zoned for butterflies and wildflowers. Woody vegetation is routinely removed and fields are mown on a one- or two-year rotation, thus allowing greatest production of grasses and wildflowers. These fields also provide good cover for ground nesting avifauna such as pheasant, quail and Song Sparrow. Other management actions for lepidoptera undertaken include the following:

– maintaining herbaceous/woody shrub edge adjoining woodland to provide a source of nectar and basking sites for woodland species.

– select planting of host plant species (i.e. milkweeds for Monarchs).

– placement of brush and woodpiles in protected areas to provide overwintering sites for Mourning Cloak and other species that spend winter in adult or larval stages.

Buckeye moth *(Junonia coenia) is a rather irregular immigrant from the south. Typically it is found in sandy locales, even on beaches. (Photo by Don Riepe)*

Butterfly weed *is the name of the flowering plant mound that grows in the Jamaica Bay Refuge at Gateway NRA and attracts butterflies to the delight of visitors. Ranger Carol Borneman examines the blossoms. (Photo by Don Riepe)*

Initial attempts to inventory lepidoptera can be problematic as many species (esp. skippers) may be difficult to identify. At Gateway, resource management staff personnel have enlisted the help of experienced amateurs from the New York City Butterfly Club and members of the Xerxes Society for survey work and baseline data collection. To facilitate inventory work, certain wildflower species were planted in representative habitat types. One plant in particular, butterflybush *(Buddleia),* was favored by many nectaring species, including some diurnal moths. It is, however, an exotic and should later be removed from strictly natural areas.

As many species of lepidoptera are attracted to dung, tree sap and rotting fruit, various concoctions can be used for inventory purposes. One recipe used by Gateway staff consisted of stale beer, molasses and overripe bananas or other fruit. Dubbed "mung" by park rangers, it readily attracted woodland species such as Question Mark and Red Admiral to tree trunks smeared with this substance. Numerous underwing and other moth species also were drawn to it and it was especially useful for nocturnal surveys.

Since butterflies, moths and other insects undergo metamorphosis and thus spend seasons in various forms with different needs, managing for them can be both challenging and rewarding. Setting aside small areas as "butterfly gardens," perhaps managed by a local garden club, may add beauty and interest to otherwise static environments. The following species listing and distribution is a summary of data to date and also an expression of the diversity of these organisms in an urban setting: 46 recorded species, in these categories – Swallowtails (3 species); Whites and Sulphurs (6 species); Gossamer Wings (7); Snouts (1); Brushroots (11); Milkweed (1); Skippers (14), and including three new species recorded in 1986, the Little Wood Satyr, the Tawny Emperor, and the Pipevine Swallowtail.

Managing for the enhancement of these macroinvertebrates is a long-term goal of this park. For more information on our program for lepidoptera write to Don Riepe, Office of Resource Management and Compliance, Gateway NRA, Floyd Bennett Field, Brooklyn, N.Y. 11234.

Riepe is a Resource Management Specialist at Gateway NRA and Tanacredi is the Park's Chief, Office of Resource Management and Compliance.

NPCA Unveils NP System Plan

"Seventy-one years after the founding of the National Park Service, the NPS research program is underfunded, understaffed, and struggling for an identity in the organization."

Thus opens the section on "Research in the Parks: an assessment of needs," in the executive summary of the National Parks and Conservation Association's National Park System Plan, unveiled at a well-publicized press conference on Feb. 18 in Washington, DC.

The nine-volume study (of which the science and research section is Volume No. 2) is the result of three years of work by a wide-ranging group of professionals from within and outside the National Park Service. The work was funded by the Andrew W. Mellon Foundation, the William and Flora Hewlett Foundation, the American Conservation Association, the Beldon Fund, and the David and Lucile Packard Foundation.

"The role of research in the NPS is ill-defined, primarily due to the lack of a specific legislative mandate directing the Service to engage in natural, cultural and social science as an essential element of its mission," the executive summary states.

"The organization of the research program historically has been unstable. NPCA found the research program to be fragmented and suffering from little policy guidance from the Washington Office (WASO). Regional research programs are structured inconsistently across regions and from park to park. Fragmentation and lack of consistency have created obstacles to inter-regional and interagency communication, and have resulted in duplication of effort," the summary continues.

Fourteen recommendations are summarized, beginning with the need for a specific legislative mandate from Congress for NPS research which "clearly defines the role of research in resource management and decision making and requires the completion of standardized Servicewide inventories of natural and cultural resources, and implementation of permanent monitoring programs."

Also recommended are a separate line item in the annual NPS budget for research equivalent to 10 percent of the total operating budget and establishment of a Science Advisory Board of "demonstrably qualified experts to provide independent, balanced and expert assessment of NPS natural, cultural, and social science research needs and programs."

On the back cover of the Executive Summary, William Penn Mott, Jr., NPS Director is quoted as saying: "I have been looking forward to the results of your work on this project and the beginning of a spirited debate on the future of the National Park System." Retired NPS Director Russell E. Dickenson also is quoted: "The insights and conclusions drawn are, for the most part, compatible with my own experience and thinking."

The Executive Summary is available immediately for $11 including postage by writing National Park System Plan, care of the NPCA 1015 31st St., N.W., Washington, DC 20007. The nine-volume Report is still in press and no price has yet been determined.

Surface Water Chemistry In Glacier Bay Ecosystems

By Robert Stottlemyer

Long-term, ecosystem-level monitoring and research provide earlier indications of environmental change and considerably improved estimates of impact magnitude. This conceptual approach is widely applied in assessing the effects of atmospheric contaminants and change in land use on terrestrial and aquatic environments. By definition, an ecosystem must have a boundary be it a terrarium or the Mississippi River basin. For research, small (<200 ha) watershed ecosystems have proven quite adequate. The goal is understanding ecosystem structure (components) and functioning (processes). The study of processes focuses on the transfer of nutrients and energy among ecosystem components.

Watersheds in a number of national parks are now used to assess impact associated with atmospheric contaminants. A major concern is the leaching of critical nutrients from ecosystems by atmospheric contaminants such as hydrogen and sulfate in acid rain. Nutrient losses often show up in streamwater draining the watershed. Long-term change in surface water chemistry has proven effective in detecting early ecosystem response to atmospheric contaminants, change in land use (Bormann and Likens 1979), and fire (Tiedemann et al. 1978). Watersheds are an ideal tool with which to assess factors responsible for natural change prior to human-induced impact (Waring and Schlesinger 1985). But such study must be conducted over the long-term for there are numerous sources of cyclic natural variation in ecosystem processes and chemistry which must be quantified before human-induced impact can be assessed.

In 1984, I and a graduate student, Jane LeTarte from Michigan Tech, began to characterize surface water chemistry and to quantify some of the natural factors responsible for its variation in the national parks of Alaska. The initial study, now completed, was at Glacier Bay National Park and Preserve. Similar study has just been completed at Lake Clark, and is underway at Denali NP and P. Support is provided through the NPS Alaska Regional Office and Division of Water Resources in Denver.

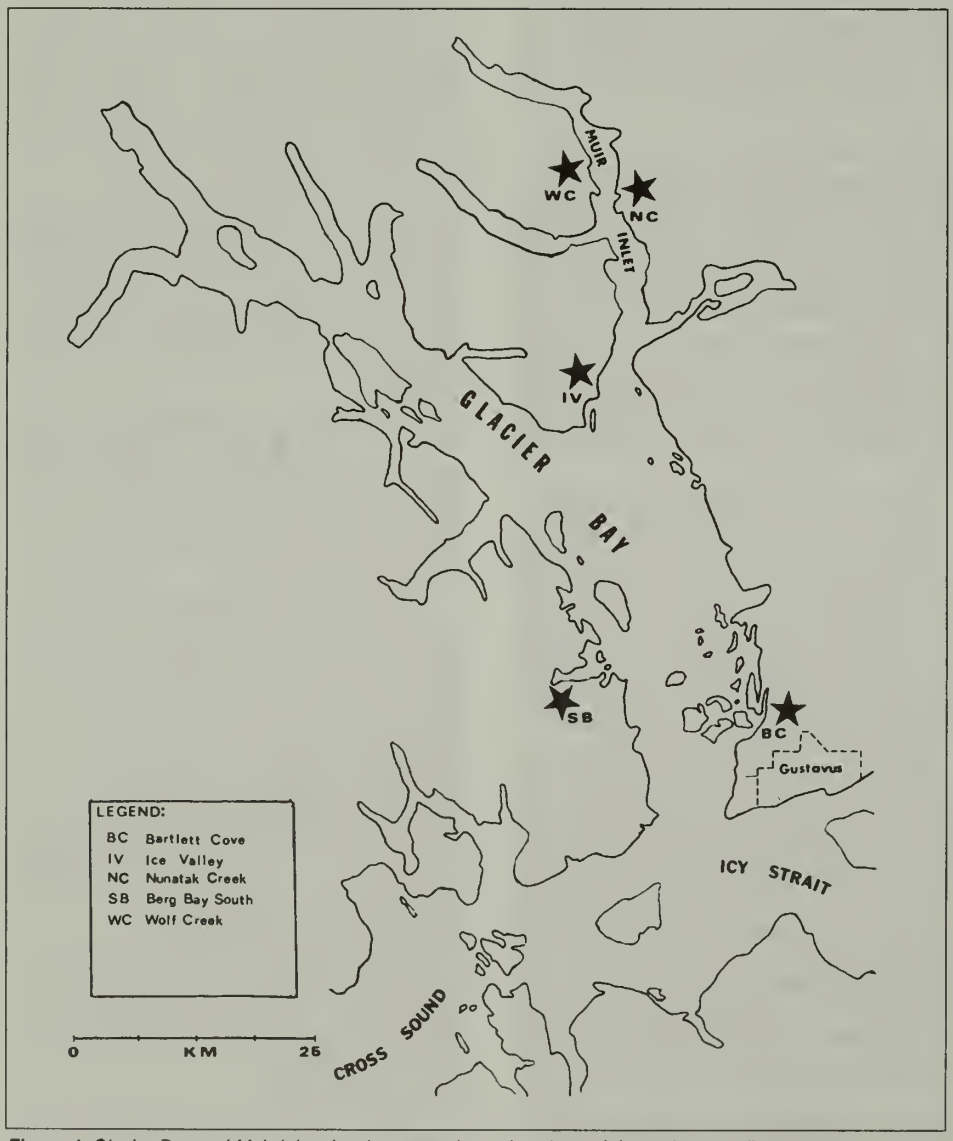


Figure 1. Glacier Bay and Muir Inlet showing approximate locations of the major sampling stations.

Glacier Bay provided both a logistical challenge and unique opportunity for this type of study. During the last 250 years a major retreat of the glaciers up the bay has exposed entire watersheds after 3700 years (Fig. 1). The result is a gradient of watershed "ages" from recently re-exposed to those deglaciated for 200 years or more. Within 25 years following deglaciation, young watersheds such as Wolf Creek (Fig. 2) began to revegetate with nitrogen fixers as *Dryas* (rose family) and alder (birch family). Nitrogen is an especially limiting nutrient for early revegetation (primary succession), and invading plants with the capacity to fix atmospheric nitrogen for use in protein synthesis have a real advantage. Later successional watersheds, deglaciated for longer periods, are subsequently vegetated with poplar, then spruce, which follows deglaciation by about 120 years. Ecosystem succession is thought to be a major factor causing variation in surface water chemistry. Thus, we had an ideal opportunity to study its effects over a spectrum of successional stages. And we had the chance to look at ecosystems undergoing change during primary succession, a process rarely studied except following volcanism.

We studied five watersheds varying from 30 to >300 years since deglaciation. The oldest was at Trap Bay, a USFS experimental area, south of Glacier Bay, where deglaciation occurred first. The most recently deglaciated was Wolf Creek (Fig. 2). In each watershed we sampled precipitation (about 200 cm/year) chemistry to determine if its quality might influence stream chemistry. Going up Glacier Bay and especially into Muir Inlet one sees a decreasing marine influence on precipitation chemistry. Sodium, magnesium and chloride, primarily of marine origin, decreased rapidly while calcium and potassium, indicative of the relative increase in land mass, increased. Sulfate, a potential atmospheric contaminant, would normally also decrease in concentration with increasing distance from its marine source. But at Glacier Bay the highest sulfate concentration was found at stations well up Muir Inlet. This suggests a local geologic source or the possibility of human-induced atmospheric contamination beneath the prevailing air inversions in this fjord.

The watersheds in earliest successional stages, Wolf and Nunatak, had the highest streamwater discharge per unit area. This reflected their proximity to active glaciers, low evaporation due to low temperatures, and less vegetation for water uptake. The amount of streamwater discharge usually affects its chemical concentration, and this source of natural variation requires long-term study to quantify. In many watersheds there are clear mathematical relationships between chemical concentration and streamwater discharge, which provide an excellent tool for looking at trends in chemical nutrient concentration. But in Alaska there are many glacially-fed drainages and annual and seasonal variation is especially large, and we did not find these relationships at Glacier Bay.

Another tool for detecting trends is watershed chemical budgets determined by measuring precipitation input and streamwater discharge of chemical species. In any solution there must be chemical equilibrium; that is, the positive-charged ions as calcium or hydrogen must be balanced by negative-charged ions such as sulfate or nitrate. With this principle we can determine if atmospheric inputs are retained in an ecosystem, or if atmospheric contaminants may be leaching critical nutrient ions as potas-

Figure 2. *Wolf Creek, a young watershed recently deglaciated.*

sium from an ecosystem. While our data base at Glacier Bay is too short (three years) to determine very accurate budgets, this principle of chemical equilibrium was applicable to other work there.

The successional stage of the watershed did have an effect on surface water chemistry. Even accounting for differences in bedrock, the loss of calcium was higher from the more advanced successional watersheds. This is likely due to the greater degree of natural acidification by organic matter in such systems. The losses of sodium, magnesium and chloride coincided more with marine atmospheric inputs. Since none of these chemical species is generally limiting nutrients, this is an expected result. Potassium losses were higher in earlier successional watersheds, which likely reflected bedrock quality, potassium's high mobility, and reduced vegetation uptake.

The trend in streamwater nitrogen losses, as ammonium, nitrate, and organic nitrogen, were the most interesting. All were much higher in Wolf Creek. We were especially interested in nitrate since it is a common, and increasing, atmospheric contaminant in many portions of the world. Also, it is a limiting nutrient in most terrestrial ecosystems. Bedrock quality does not affect nitrogen since it must come from atmospheric inputs and/or be fixed by biological processes within the watershed. Our precipitation chemistry showed only trace levels of nitrate or ammonium so we knew any found within the watersheds had to be of biological origin.

In order to better explain why there were such differences in stream chemistry, we focused on the effect of primary succession, particularly that of invading nitrogen-fixing vegetation, on soil and soil water chemistry. Within 30 years following deglaciation, soil pH decreased from 7.4 to 6.3 due just to unaltered precipitation inputs (Fig. 3). After 50 years, which included 20 years of revegetation by alder, the surface soil pH decreased to 4.71. This is a >500x increase in soil acidity in 55 years – all due to natural processes. With the invasion of alder, soil organic matter (shown as carbon in Fig. 3) increased. Organic matter, along with clays, is a major factor increasing soil retention of critically needed ions. This retention ability, or "cation exchange capacity," reflects the rapidly increasing capacity of these soils to retain calcium, magnesium, potassium, and ammonium. But the rapid gain in hydrogen, as measured by a decrease in pH, displaced some base ions from these retention sites, and the "base saturation" was decreased.

In examining similar data from soils in our watershed deglaciated >300 years ago, these soil properties had not greatly changed from those observed at 175 years. Thus, the greatest change in a number of ecosystem indicators often used to assess human impact, as from acid rain, show considerable natural variation during primary succession. It would be difficult to separate soil change due to acid rain during this time. And in late successional stages, it would also be difficult because of the huge hydrogen pool built up by natural processes in soil. One would need long-term, accurate data to separate the source of trends.

What was the main cause of soil acidification with alder? Nitrogen fixing! In the nitrogen cycle atmospheric nitrogen and hydrogen are symbiotically combined near plant roots and transformed to ammonia, which can be altered to nitrate or organic nitrogen. Alder fixed far more nitrogen than it could biologically utilize. With no other plants to use the excess nitrate, as would be present in later successional stages, there was excess in the soil water. As previously mentioned, chemical equilibrium must be maintained in solutions. We found that all the base or positively-charged ions, as calcium and potassium, in soil water beneath the plant roots were balanced by the negatively-charged nitrate concentration. So nitrate accounted for leaching base cations from the soil leaving hydrogen to acidify it. Ironically, the ecosystem's most rapid acidification resulted from its loss of nitrate, a critically limiting and strongly conserved nutrient in later ecosystem successional stages.

Most ecosystems have undergone such pronounced change at one time or another. We must first understand such ecosystem processes before we can be certain we are maintaining them, and this step is a prerequisite to preserving biological diversity. Much effort has gone into assessing various research tools by which we may monitor ecosystem functions. But there is considerable need to more fully quantify the sources and magnitude of natural variation for these tools to be more effective. From such study we will gain much needed new insight into ecosystem processes.

Stottlemyer is a Research Scientist with the NPS Great Lakes Area Resource Studies Unit at Mich/Tech/U, Houghton, MI 49931.

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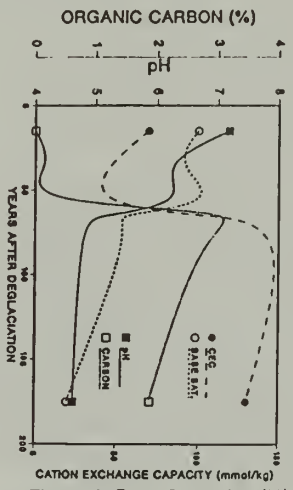

Figure 3. *Base Saturation (%).*

Interpretation of natural resource management practices *at Cuyahoga Valley NRA is the subject of an article by Supervisory Park Ranger Carol Spears, to be published in a spring 1988 issue of the NPS* Courier. *Here, visitors participate in a park tagging program by capturing monarch butterflies.*

Mount Rainier: Fire and Ice

By Mark Huff

Wildland fires are not an everyday event at Mount Rainier National Park (MORA): the climate is notoriously wet and lightning storms are rare. The mean fire-return-interval for MORA's montane forests exceeds 400 years (Hemstrom and Franklin 1982). Likewise, subalpine forests east of Mount Rainier burn infrequently; I have found fire-return-intervals of about 300 years on dry sites and considerably longer intervals for more mesic sites.

The infrequent fire record might lead one to underestimate fire as an integral component of MORA's natural processes. In forests composed of long-lived tree species, the time scale between fires can be deceptive. Most of the forested portion of MORA has burned one or more times over the last 1000 years, even though the presence of past fires is concealed by the reestablishment of new forests. Whether small or large, fires at MORA have created an array of patterns over forest landscape, diversifying the natural beauty of the park. Though MORA is famous for record-setting snow accumulations, magnificent old-growth forests, massive glaciers, and stunning vistas of the "mountain," when one of the long-awaited fires occurs, one cannot but take notice.

To the surprise of park managers and scientists, on May 7, 1987, during the middle of subalpine spring snowmelt, three subalpine fires were ignited in MORA by a lightning storm that swept through the Washington Cascades. These fires burned almost exclusively in tree crowns, leaving the partially snow-covered understory, for the most part, unburned. In 1986, a similar type of subalpine fire occurred in the Oregon Cascades on Willamette National Forest, once again during spring snowmelt. Since the MORA fires are not an isolated incident, the significance of spring subalpine fires is just now being realized.

The occurrence of spring subalpine fires adds a new dimension to our perception of subalpine fire dynamics in the Pacific Northwest. Park scientists and managers were quick to realize the need and opportunity to examine the ecological effects of such fires. Through cooperation between NPS Cooperative Park Studies Unit/University of Washington and its ongoing Pacific Northwest fire ecology projects (coordinated by Jim Agee, Research Biologist), NPS Pacific Northwest Regional Office (Jim Larson, Regional Chief Scientist), and MORA (Bob Dunnagan, Assistant Superintendent for Resources Planning), funding was pieced together to initiate a small study.

Objectives of the study are to 1) document the ecological effects of a crown fire burning over a snow-covered understory, 2) simulate environmental conditions and behavior of the fire, and 3) establish a permanent ecological research site to monitor the long-term effects of the fire on a north-facing slope.

Study Area

The study focuses primarily on the South Mowich Fire, largest of the three subalpine fires, approximately 25 ha (62 ac). It burned the steep north and south slopes of a knife-edged spur-ridge between the North and South Forks of the Mowich River, on the northwest flank of Mount Rainier. The Paradise Fire burned ‹ 0.04 ha (‹ 0.1 ac) near the Paradise Visitor Center. The North Puyallup Fire burned approximately 6 ha (15 ac) on the south aspect of a steep east-west spur ridge above the North Puyallup River, the next watershed south of the Mowich River.

Data were collected and a permanent plot was established at the South Mowich Fire, on the north side of the ridge, at approximately 1705 m (5,600 ft) elevation. Here, the main tree species are mountain hemlock *(Tsuga mertensiana)* and Pacific silver fir *(Abies amabilis)*. The ground cover is dominated by red mountain heather *(Phyllodoce emptriformis)*, partridgefoot *(Luetkea pectinata)*, and Cascade blueberry *(Vaccinium deliciosum)*.

Fire Weather and Burning Conditions

On May 4, after several days of cold rain and snow in the subalpine zone: a strong Pacific high pressure cell moved onshore bringing unseasonably dry and warm weather to the Pacific Northwest. This front dominated regional weather for the next 7 days, until a low pressure system brought rain on May 12. For the duration of the high pressure cell, weather typical of mid-summer prevailed. Temperatures ranged from 63-74 degrees F for six days at MORA's subalpine weather station near Paradise Ranger Station. East and northeast winds carried very dry air centered east of the Cascade Mountains westward to create "fire weather," more typical of the summer months in the Pacific Northwest (Huff and Agee 1980).

Weatherwise, the stage was set for a fire to burn, although ground fuels were buried under deep snow or saturated with snowmelt water and incapable of carrying a fire. If log moisture alone had been used as indicator of fire danger (no moisture measurements were made), no fire danger would have existed.

Since spring subalpine fires tend to be crown rather than surface fires, tree crown moisture should be the most reliable indicator of fire danger. Although no moisture measurements were taken, I suspect that needle moisture was critically low at the time of the fire. Subalpine tree roots were anchored in near freezing soils making the translocation of water from the root system up to the foliage difficult. During the 8 days of warm dry weather, transpiration demands for water within the trees must have been high, thereby making the water-starved needles susceptible to burning.

Fire Behavior

More is known about the behavior of the Paradise Fire than the other two fires. The fire fighting crew observed the Paradise Fire spread slowly among tree crowns of subalpine fir *(Abies lasiocarpa)* and mountain hemlock: 1) by igniting lichens draped along the fine branches, 2) preheating and igniting the foliage, and 3) spreading to a nearby tree by igniting its lichens, starting the burning cycle over again. Intensity was most severe near standing dead trees. Ground fuels in the burning tree islands were snow-free, but none was consumed. Outside the tree islands snow was a meter deep and in the process of melting; this provided a steady flow of water over the forest floor keeping the surface fuels damp.

With the aid of excellent road access and several tanker truck loads of water, the Paradise Fire was extinguished within three hours after ignition. If control action had not been taken, it is likely that this fire would have burned at least another 5 days and grown larger, potentially threatening the Paradise Visitor Center and recreational facilities nearby.

The South Mowich Fire was not discovered until May 10, three days after ignition. It is assumed that the fire smoldered for the first three days, then took off as conditions got drier. Most of the burning took place on May 10 and 11. The fire ignited on the steep (› 80%) south slope at around 1580 m (5200 ft) elevation, which appeared to be snow-free at this time. The fire spread in three directions: 1) downslope, probably as a result of rolling firebrands; 2) cross-slope in a northeasterly direction; and 3) upslope over the ridge and down the snow-covered north slope. The fire spread appeared to be more rapid on the south slope. Here, the tree canopy was more or less continuous, the slope was steeper, and conditions were drier than the north slope, where trees are clustered among small, snow-laden meadows.

Permanent Plot

One 50 x 50 m permanent plot was established on the north slope of the South Mowich Fire. Herb and shrub cover was measured in 40-0.5 sq m subplots around the perimeter of the permanent plot. All tree saplings between 0.2-2.0 m were identified to species, height measured, and mapped. All trees › 2 m tall were tagged, identified to species, determined whether live or dead, and mapped; diameter, total height, and scorch height were measured; and the amount of crown damage by heat scorch or needle consumption was estimated.

Ecological Effects of the South Mowich Fire

As the fire moved through the tree canopies on north slope, most of the actual burning took place in the foliage of tall, large 400-600 year-old mountain hemlocks. The foliage of the shorter, 300-450 year-old, Pacific silver firs was generally only singed. If the canopy of a Pacific silver fir was set ablaze, usually only a small proportion was consumed. Foliage damage to Pacific silver fir was more severe, especially if it grew close to mountain hemlock. Because of this, I suspect that hemlock was more sensitive to desiccation and apt to burn more intensely than Pacific silver fir.

The canopies of all trees › 5 m were either heat scorched or consumed by the fire. However, initial survival of trees › 5 m was high, nearly 60 percent. Still, most of the survivors had more than 50 percent crown damage, and a large proportion of these trees will likely die over the next year or two.

Because of snow, the scorch line on most tree boles started at 5 m above the ground. Trees ‹ 5 m height, if affected by the fire, were heat scorched only. Sixty-three percent of the trees ‹ 2 m height were unaffected. The patchy distribution of scorching within the understory indicates that snow depth at the time of the fire was variable. The least amount of scorching occurred in the meadows being invaded by small trees, where apparently snow was deepest. At locations where trees grew close together, the fire in some instances burned down to the ground inside the snow-well that surrounded the trees.

Trees between 0.2-2 m height were abundant, numbering › 5,000 trees/ha. Pacific silver fir dominated this tree layer: 74 percent Pacific silver fir, 19 percent mountain hemlock, and 7 percent other species. These small trees are expected to be dominants as the stand develops over the next few centuries. If so, the new forest canopy will be somewhat different from the old forest canopy that existed before the fire: 48 percent Pacific silver fir, 48 percent mountain hemlock, and 4 percent other species. The species mix of equal

***North slope** of the South Mowich fire on the northwest flank of Mount Rainier is shown here as it looked on June 3, 1987, 27 days after the fire started. Many of the tall trees have sparse crowns from being burned and snow still remains between the tree clusters.*

amounts mountain hemlock and Pacific silver fir is expected to give way to a forest dominated by Pacific silver fir. Because Pacific silver fir is the more shade tolerant species, this fire has essentially moved the species composition closer to "climax," quite the opposite effect of fires burning in the summer months.

Management Implications

This year MORA has completed a draft fire management plan, in which some natural fires will be allowed to burn under a proposed management prescription. Because MORA is only 95,339 ha (235,404 ac), 25 percent of which is rock, snow and ice in the central mountain core, and because it has merchantable timberlands surrounding a large portion of its borders, natural fire management is difficult. Spring subalpine fires, however, are a low risk phenomenon. They will most likely be relatively small in size, be confined to the subalpine, and burn for only a few days.

Mark Huff, a forest and wildlife ecologist, is a member of the research faculty at the College of Forest Resources, University of Washington. He has been intensively studying the ecological aspects of fire in Pacific Northwest National Parks since 1978. *Field assistance was provided by Mignonne Bivin, Carol Bernthal, Janet Christiansen, and Kevin Cooper.*

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Galápagos Botanical Management Provides Perspectives for Hawaii

By Clifford W. Smith, Charles P. Stone, and Lloyd L. Loope

The biota of the Galápagos Archipelago, like that of Hawaii and many other oceanic island groups, is becoming increasingly threatened by aggressive introduced plants and animals. The threats to endemic tortoises and iguanas have been relatively well publicized; active management programs have been undertaken, with notable success, to assure survival of reptile populations of certain islands. In contrast, threats to survival of endemic plants have received relatively little attention, perhaps partly as a result of the absence of showy species and superlative examples of adaptive radiation (i.e. groups such as the Hawaiian tarweeds and lobelioids). It is becoming clear that unless feral ungulates and alien plants in the Galápagos are managed aggressively, the rich botanical resources of this renowned national park and World Heritage Site will be severely damaged in the long run.

A "Workshop on Botanical Research and Management in Galápagos" was held April 11-20, 1987, at the Charles Darwin Research Station on Isla Santa Cruz, Galápagos. The workshop, sponsored by the Charles Darwin Research Station (CDRS), the Galápagos National Park Service (GNPS), and the Catholic University of Ecuador in Quito, was an attempt to develop a framework for preventing any further decline of the Galápagos flora. Financial support for the meeting was provided by the MacArthur Foundation; a proceedings volume will be published by Missouri Botanical Garden. The workshop was attended by 95 registrants, of whom about 60 were Ecuadorians. Five of us were from Hawaii, 15 others from U.S. institutions, and the rest were primarily European. Two New Zealanders, one from Japan, and one from South Africa also participated. Efficient simultaneous Spanish/English translation (the first ever at a conference in the Galápagos) allowed for effective communication.

The problems facing the Galápagos are essentially the same as in other oceanic island groups. Some of the recommendations developed from the workshop included renewed emphasis on fundraising and education inside and outside the Galápagos; increased monitoring and research and better use and protection of the data generated; improved control of tourism and alien importations; more emphasis on both inventories and long-term studies; focus on relatively important ecological areas, particularly on uninhabited islands that are most intact; *in situ* protection of the biota through removal of alien influences and exclusion by fencing; and *ex situ* conservation through expansion of both Galápagos and external programs.

Priorities identified for alien species research included identifying plants to be controlled by herbicides and increasing research on various chemicals to control them; management of weeds and introduced animals on uninhabited islands; mapping of weeds; and biocontrol introductions. Use of outside expertise for alien animal and plant control was recommended. The international community, particularly USNPS, could also be involved in more systematic training of GNPS personnel in principles and practices of conservation biology. The information generated at the meeting will be used to plan for a better future and to seek further funding for conservation biology in the Galápagos.

The Galápagos National Park itself and the institutions involved in its protection are impressive by any standards. The national park was established in 1959 and expanded in 1968 to include 96 percent of the land area of the archipelago or 2,960 square miles.

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Regional Chief Scientists

Anderson, William H.
NATIONAL CAPITAL REGION
1100 Ohio Drive, S.W.
Washington, D.C. 20242
8(202)342-1443

Dottavio, Dominic
SOUTHEAST REGION
75 Spring St. S.W.
Atlanta, GA 30303
8-242-4916 (404) 221-4916

Karish, John R.
MID ATLANTIC REGION
Ferguson Bldg, Room 209-B
Pennsylvania State University
University Park, PA 16802
8(814)865-7974

Kilgore, Bruce
WESTERN REGION
450 Golden Gate Ave.
P.O. Box 36063
San Francisco, CA 94102
8-556-4968 (415) 556-4968

Ruggiero, Michael
MIDWEST REGION
1709 Jackson St.
Omaha, NE 68102
8-864-3438 (402) 221-3438

Huff, Dan
ROCKY MOUNTAIN REGION
P.O. Box 25827
Denver, CO 80225
8-327-2650 (303) 969-2650

Larson, James W.
PACIFIC NORTHWEST REGION
83 S. King St., Suite 212
Seattle, WA 98104
8-399-4176 (206) 442-4176

Soukup, Michael
NORTH ATLANTIC REGION
15 State Street
Boston, MA 02109
8-835-8805 (617) 565-8805

Fletcher, Milford
SOUTHWEST REGION
P.O. Box 728
Santa Fe, NM 87501
8-476-6412 (505) 988-6412

Lovaas, Allan L.
ALASKA REGION
2525 Gambell St., Room 107
Anchorage, AK 99503-2892
8 (907) 257-2568

Please address requests for information to appropriate Regional Chief Scientist.

In 1986, the Ecuadorian government declared an additional 31,000 square miles a Marine Resources Reserve. The national park staff (GNPS), funded by the Ecuadorian government, now numbers about 30 employees. CDRS, established in 1959 under the auspices of UNESCO and funded internationally, has about 50 staff members as well as numerous visiting researchers and students. The function of the CDRS is research, both basic and applied, whereas GNPS is responsible for management. The greatest single problem appears to be lack of adequate funding for the GNPS, quite understandable in view of the difficult economic situation in Ecuador, but no less debilitating as a bottleneck hampering park management. The severity of logistic difficulties in the Galápagos is difficult for most North Americans even to imagine. Nevertheless, an outstanding literature relevant to conservation biology in island ecosystems has resulted from research carried out by CDRS. The relatively high quality of the accumulating data base is suggested by a recently published volume (Robinson and del Pino 1985) on effects of the 1982-83 El Niño event on the Galápagos biota.

Those of us from the Hawaiian Islands were, of course, fascinated with the Galápagos microcosm of evolution in isolation, the striking vulnerability of the biota to environmental alterations by man and his introductions, and the obvious parallels with the Hawaiian situation. We were able to contribute significantly to discussions identifying the problems as well as research and resource management needs. The threat to the Galápagos flora is less immediate than the parallel problem in Hawaii due to the more recent human occupation and substantially lower population. Nevertheless, many of the same pressures for further development and environmental deterioration are present, e.g. a marginal agricultural industry looking for alternatives, uncontrolled importation of plants.

We have taken advantage of our visit to publish comparative papers elsewhere (Stone *et al.* in press, Loope *et al.* in press). More importantly, our dedication to strengthening research and management in oceanic island ecosystems has been reinforced and enriched by the opportunity to obtain a close look at the situation in "Darwin's Islands."

The unique possibilities for obtaining detailed understanding of evolutionary processes through ecological research on islands is well illustrated by work on the Galápagos finches (Lack 1947, Grant 1986). Numerous other Galápagos studies complement the noteworthy body of literature on evolutionary biology from Hawaii (recently reviewed in an entire issue of *Trends in Ecology and Evolution,* July 1987, Vol. 2, No. 7). These tiny archipelagoes with their fascinating and highly endangered plants and animals require and deserve much more concerted and better-funded conservation research and management efforts than they are getting. Neither can continue to serve as important evolutionary laboratories for the future without positive human intervention on their behalf.

Smith is NPS/CPSU Director at U/Hawaii; Stone and Loope are NPS Research Scientists at Hawaii Volcanoes and Haleakala NPs, respectively.

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